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User's Manual

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IMPORTANT

Read this manual prior to operation.

Purpose

The purpose of this manual is to provide vLBV operators with a clear understanding of the proper and safe operating procedures. It is a valuable reference tool and should be thoroughly reviewed prior to the operation of the vLBV. If any part of this manual regarding the use of the vLBV is unclear or not thoroughly understood, please contact SeaBotix Inc. or any authorized distributor for more detailed information.

Before operating the vLBV, it is important to read this manual thoroughly to understand the proper use and precautions required for its safe operation. Throughout this manual information of special interest is highlighted with the following symbols. Be sure to read and understand each of these important messages.

Safety Symbols

Indicates a hazardous situation which, if not avoided, will result in death or serious injury.

Indicates a hazardous situation which, if not avoided, could result in death or serious injury.

Indicates a hazardous situation which, if not avoided, could result in minor or moderate injury.

Indicates a situation which if not avoided could result in data loss or equipment failure.

INFORMATION notes to assist the operator.

Potential Hazards

Although the vLBV is a safe and reliable tool when used and cared for properly, there are certain inherent safety hazards associated with the operation of the vLBV that should be reviewed and avoided. SeaBotix Inc., and its distributors, associates, and affiliates, cannot be held liable for any damages, injuries, losses or problems whatsoever resulting from negligent operation, or a vLBV system that has been altered or modified without the prior written consent from SeaBotix Inc.

Thruster Propellers

Keep the propellers clear of obstructions at all times.

Do not put fingers or other objects near the propellers at any time.

Be careful with any loose clothing, jewelry, etc.

Three Jaw Grabber

High closing force, (2.5 bar/36.5 psig)! Keep clear of the jaws when testing.

Lighting

Each light head is capable of outputting 1080 lumens, do not look directly into the lights when testing, or during system operation.

If operating with divers, advise them to avoid looking at the vLBV lights.

Electrical Shock

The vLBV operates at high voltages that can cause injury and/or death.

Keep the Surface Power Supply plug away from water.

Check all plugs for the presence of water prior to connecting.

If the tether is cut, chafed, or otherwise damaged, do not operate the vLBV.

Do not open the vLBV electronics housing when the power is on.

Equipment Cooling

.

The vLBV is a water cooled device. DO NOT operate in air for more than 15 minutes, damage may result.

The SPS3020EH is an air cooled power supply ensure adequate air flow for proper cooling.

Testing

Each vLBV system is carefully manufactured to ensure long term safe operation. Prior to shipment, every vLBV is tested for proper operation, including pressure testing to full operating depth. Should a defect be found, contact SeaBotix Inc. or an authorized distributor immediately.

Design and Documentation Changes

SeaBotix Inc., reserves the right to make changes to the specifications of the vLBV and/or alter any documentation at any time, without notice.

Connectors

Connectors used on and in the vLBV system are primarily plug style connectors. Rotation or lateral movement on the connections when mating/un-mating can cause damage to the connectors.

Section 1: Introduction to the vLBV

The vLBV represents a radical new design concept in small ROV's. Upgrades in electronics, and innovative design allow for the incorporation of many new features and capabilities into this small footprint.

Data communications to and from the vLBV is via 100MBps Ethernet data line. This large bandwidth capability allows the vLBV to employ a large optional sensor package load while maintaining a separate video data stream.

There are three (3) RS232 to Ethernet adapters and one (1) RS485 to Ethernet adapter available. These allow the vLBV to transmit serial sensor output data to the processor topside for display.

Electronic Improvements:

While only one (1) camera can be displayed at a time, the vLBV supports up to four (4) attached composite video sources.

One (1) video input can be an HD video source.

Individual head external lights are installed with independent lighting controls. This allows the operator to adjust the lighting to prevent hot spots and improve image quality

The forward external lights mechanically track the main camera tilt angle.

An optional spot light can be attached to the forward primary camera to improve the video detection range in water with >10m visibility.

An improved Sensor Nav Board with a high resolution 3D digital compass.

Mechanical improvements:

A modular floatation system, designed for neutral buoyancy in the basic system configuration.
Additional floatation can be added to accommodate up to 10kG of additional payload.

Brushless DC thrusters with three bladed 100mm propellers provide for greater thrust.

The system is equipped with a total of six (6) thrusters, two (2) for the vertical axis and four (4) for the horizontal axis.

Vectored mounting angles for the horizontal thrusters, with two angles forward, and three angles aft, are providing up to 22.7kG of forward thrust, and up to 15.3kG of lateral thrust. (See table.)

vLBV Thruster Configurations	Forward Angle	After Angle	Total Forward Thrust	Total Lateral Thrust
1	35^0	18^0	21.1 kG	10.5 kG
2	35^0	35^0	19.6 kG	13.7 kG
3	35^0	45^0	18.2 kG	15.3 kG
4	18^0	18^0	22.7 kG	7.4 kG
5	18^0	35^0	21.1 kG	10.5 kG
6	18^0	45^0	19.8 kG	12.1 kG

Configuration three is the factory standard.

The separate sealed electronics bottle was designed to allow the operator to quickly change out the entire bottle in the event of an electronics fault, and return to operations in less than 30 minutes.

A comprehensive mechanical and electronic assembly design, with maintainability being as important as ease of operation. All components and assemblies were designed to make replacement of any single component possible in a matter of minutes.

Newly designed removable thruster propeller guards are integrated into the propeller nozzles. Removing the thruster propeller guards will reduce the potential for propeller fouling and subsequent damage when operating in areas with floating marine growth, for example kelp.

Propeller attachment redesigned as a collet and nut system, making removal and replacement of propellers simpler.

1.1 Unpacking System

The system will arrive individually packed in rugged watertight transit cases protected by cardboard boxes.

The standard basic system will arrive in at least five separate boxes, marked with their primary contents.

1	vLBV
2	Universal Reel System
3	Surface Power Supply
4	Integrated Navigation Console
5	A box with spares, documentation and software

Upon receipt, open and visually inspect each case and its contents. Verify that the system is undamaged and that all items ordered are provided.

1.1.1 vLBV (vectored Little Benthic Vehicle)

1. Verify the affixed tag noting the water type for which the vLBV is trimmed for, Salt (Green) or Fresh (Blue).

2. If a Three Jaw Grabber was requested, verify that it is mounted to the vLBV.

3. Verify the correct number of external lights and mounting configuration.

4. Verify the proper number of cameras are installed and note their location.

5. Verify additional sensors mounted such as scanning sonars, multi-beam sonars, tracking systems or other sensors per the sales order.

NOTE: Due to packaging considerations, some sensors may not be mounted to the vLBV upon arrival, but will be included in the shipment along with instructions for mounting and connecting prior to use.

1.1.2 URS (Universal Reel System)

1. Verify that the delivered reel matches the order.

2. Verify that the reel handle is in place.

1.1.3 SPS3020EH (Surface Power Supply)

1. Open the cardboard packing case and inspect the exterior of the case for damage.

2. Verify the correct electrical connectors for your location are installed on the power cables provided with the unit.

NOTE: In some cases, the power cables will not be terminated with a connector, in this case, the wires will be stripped back in preparation for installation of connectors, and a tag will be attached indicating the proper connections by wire color.

1.1.4 INC (Integrated Control Console)

1. Open the cardboard packing case and inspect the exterior of the case for damage.
2. Open the case and lift the OCU (Operator Control Unit) from its storage location, test operation of the joystick, and the vertical thruster control knob.
3. Visually inspect the monitor for damage.

NOTE: Retain the cardboard container for the INC. If the INC requires return to SeaBotix, shipping damage can be prevented by utilizing the original packaging.

Manuals and Cables:

The vLBV documentation, additional cables required for operation, and any software required for operation of installed accessories will be located in a separate package. Utilize the packing list to verify that all items are delivered.

1.2 Power Requirements

Voltage and Power required: 110VAC or 220VAC 4kW minimum.

The SPS3020EH is designed to operate on either 110VAC or 220VAC.

Due to the lower voltage and efficiency, it is recommended that when using 110VAC for power, the unit is powered via separate 20A supplies.

Do not operate the system from an Uninterruptable Power Supply.

It is not recommended to operate the system from a GFI protected circuit.

Any and all primary power connections must have an earth ground reference

Do not utilize signal conditioning circuits on the primary power connections.

Ensure that any extension cords utilized are of sufficient gauge to carry the 2-4kW of power. This can be tested by verifying no more than a 10VAC drop over the length of the cable when under load.

Failing to adhere to the above notices may result in improper vLBV operation or damage to the equipment.

1.3 Setting Up the System

The basic system requires only a few cable connections and a power source to be up and running.

It is recommended that the user always start at the vLBV, and work from there to power. In addition, the shackle on the vehicle end of the tether should be attached to the vLBV prior to making any other connections.

DO NOT attempt to connect the tether to the vLBV while voltage is applied. This will result in damage to the vLBV electronics.

When connecting and testing the vLBV, a dry well lit work space is recommended. Place the system components on stable surfaces, arranged so that the operator can reach all controls easily.

The vLBV is designed as a water-cooled device. Operation in air should be kept to 15 minutes or less to prevent component damage from heat build up.

It is recommended that the following portions be read completely prior to performing any of the steps. This allows the operator to have a basic understanding of the goals and steps outlined in the proceedures prior to starting.

1.3.1 Universal Reel System (URS)

When setting up the Universal Reel System (URS) there are a few considerations that should be taken into account.

1. Set the reel up so that the tether is deployed off of the spool towards the area where the vLBV will be operated.

2. Route the cables from the Pull Out Hub so that they are protected from traffic and not a trip hazard.

3. Set the URS as close to the water as possible. This will reduce the amount of vLBV tether in a potential transit area.

1.3.4 Surface Power Supply (SPS3020EH)

NOTE: When connected to 110VAC, two separate 20A supplies must be utilized to avoid overloading the wiring.

1.4 Pre-Dive Inspection and System Operability Tests

Prior to placing the vLBV in water for the first time or after repairs, a vacuum test should be performed on the Electronics Bottle Assembly.

The vacuum fitting is located on the aft end of the Electronics Bottle Assembly adjacent to the electrical and fiber optic tether connections. Connect the supplied vacuum pump hose to the vacuum fitting, and verify that the system reads between eight to ten (8-10) inches of mercury vacuum.

1.4.1 Vacuum Test

It is recommended that this step be performed prior to shipping and at least one day prior to operation.

Locate the vacuum fitting. Use a #2 Phillips screwdriver; remove the 10-32 Phillips head seal screw.

Install the hose fitting for the vacuum test fixture and read system vacuum.

System vacuum should read from 8 to10 in Hg

If the reading is less than eight inches of mercury, the vacuum should be increased to ten inches and held for ten minutes. If the needle moves at all, the Electronics Bottle Assembly fails the vacuum test.

Once the vacuum test is complete, fully connect the system and power the vLBV. Test the operation of all features and devices.

NOTICE

The vLBV is a water cooled device. Do not operate in air for longer than 15 minutes as damage can occur to the electronics.

NOTICE

When testing the vLBV lighting, only operate them in air long enough to verify that they operate, then turn them off. Water cooling is required for extended operation of the light heads.

1.4.2 System Inspection

Prior to operation, verify that all components are present, cables, accessories etc.

Visually inspect all portions of the system. Verify that no damage has occurred during the last use, or during transit.

1.4.3 Connecting and Powering up the vLBV

NOTICE

Always connect the system starting with the vLBV and work backwards to the power source. This is to prevent accidental connection of the tether to the vLBV while power is applied. Connecting the tether to the system while power is applied may result in damage to the electronics.

A Release the reel lock on the URS.

B Deploy 2-3 meters of tether from the URS (Universal Reel System)

C

Attach the shackle to the pad eye at rear of the vLBV.

D

Connect the 8 pin wet mateable connector to the 8 pin bulkhead connector on the rear of the Electronics Bottle Assembly.

E

Remove the tether whip from the storage posts, and route the cables to the SPS3020EH.

F

Connect the 8 pin male tether whip connector to the 8 pin female connector on the SPS3020EH.

G

Connect the SPS3020EH power cable to the input connector on the SPS3020EH

H

Connect the CBA210 (the cable with the circular metal connectors) between the SPS3020EH and the INC300

J Connect the power cable to supply power

K

Power up the SPS3020EH

L

The red power light will illuminate within one second. Wait approximately two seconds for the amber status light to illuminate before proceeding

M

Power up the INC300

N

Press the CPU switch on the INC300 lower panel assembly to boot the processor

P

Press the POWER key on the Operator Control Unit.

The operator will hear the SPS3020EH power supplies increase noise output. This indicates that they are supplying power to the vLBV.

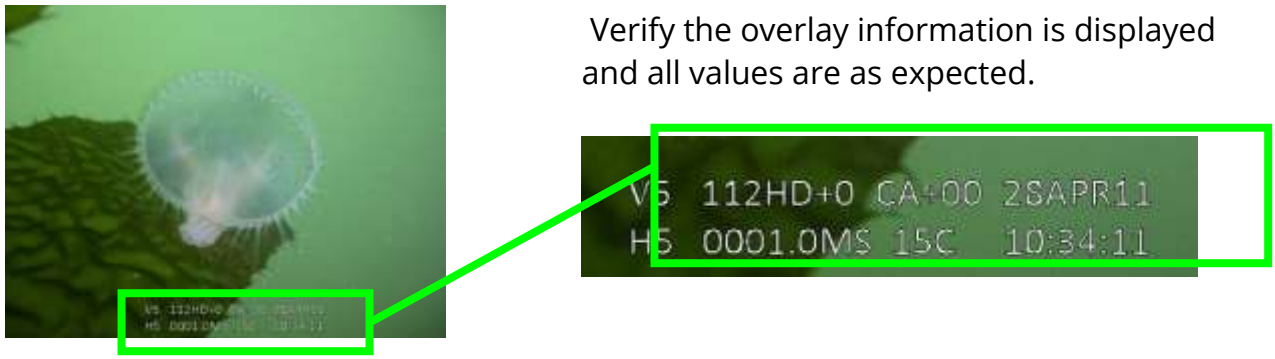
Q

The amber status light on the SPS3020EH will now begin to strobe, 2 seconds' on & 2 seconds off.

R

Verify that video is displayed on the INC monitor.

S



Verify the overlay information is displayed and all values are as expected.

System power up sequence complete.

1.4.4 Operational Testing

Operational testing involves verifying that all components are functional.

A. Verify video present from all installed cameras.
B. Verify that all thrusters operate.
C. Verify all installed lights operate.
D. Verify all installed accessories operate.
E. Verify all installed external sensors operate.
F. Check the compass heading displayed on the video overlay, and verify that it is correct.

The compass output can be affected by ferrous metal and electrical power transformers in close proximity to the vLBV. Test the compass at least one meter away from these materials.

G. Verify the depth sensor output is at or near zero in air.

The vLBV should be in view of the operator or if available a second person in communications with the operator can be used to assist.

NOTICE

The vLBV is designed for water cooling. Do not operate in air for longer than 15 minutes as damage can occur to the electronics.

1.4.4.1 Thrusters

Using the Operator Control Unit (OCU) press the joystick to full forward. All four (4) thrusters on the horizontal axis will operate. Verify all propeller blades spinning. Aft mounted thrusters clockwise and forward mounted anti-clockwise.

Rotational reference for thrusters is with the operator looking directly at the propeller end of the thruster.

Using the OCU press the joystick fully to the rear. All four thrusters on the horizontal axis will operate. Verify all propeller blades spinning forward mounted thrusters clockwise and aft mounted anti-clockwise.

Using the OCU, rotate the control knob at the top of the joystick fully clockwise. Starboard aft thruster will run anti-clockwise, starboard forward thruster will run clockwise. Port aft thruster will run clockwise; port forward thruster will run anti-clockwise.

Using the OCU, rotate the control knob at the top of the joystick fully clockwise. Starboard aft thruster will run clockwise, starboard forward thruster will run anti-clockwise. Port aft thruster will run anti-clockwise; port forward thruster will run clockwise.

To verify rotational direction, the operator may need to reduce the rate of thrust, by backing off the joystick controls.

Using the OCU; rotate the vertical thruster control knob forward to full dive. Verify that both port and starboard vertical thrusters rotate clockwise.

Using the OCU; rotate the vertical thruster control knob ft to full surface. Verify that both port and starboard vertical thrusters rotate anti-clockwise.

1.4.4.2 Camera Controls

Since the vLBV can use multiple cameras, the operator should verify video output from each installed camera.

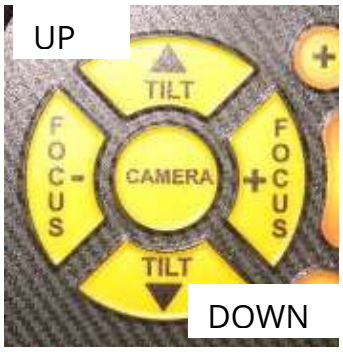
When multiple cameras are installed, the process for selecting the displayed camera is to press and hold the camera button while selecting the desired camera's number.

2= Bow (Primary) Camera
5= Zoom Camera (Bow Secondary)
7= Port
9= Starboard
0= Aft

Default camera for display on vLBV power up is the primary camera: (Camera Selection 2.)

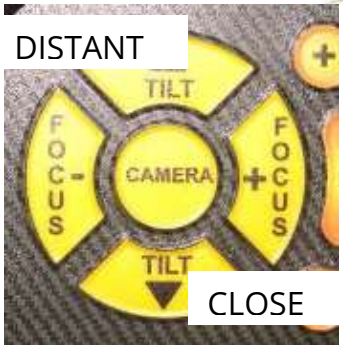
Bow, Zoom, Port, Starboard and Aft cameras are optional.

After verifying video output from all installed cameras, the operator should verify the tilt control and readings for the forward mounted camera/s.



Use the tilt up and tilt down buttons on the OCU to drive the forward camera/s to full up and full down position. Verify that the overlay displays +90CA for full up and -90CA for full down.

Return the camera to 00CA and visually verify that it is centered with the vLBV.



If the cameras equipped have variable focus, verify the focus controls operate. Press FOCUS + for close focus and FOCUS – for distant focus.

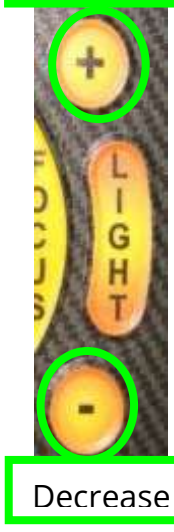
Experience shows that a focus range of approximately 1.5m provides good focus range and depth of field for most operational requirements.

1.4.4.3 Lighting

NOTICE

When testing the vLBV lighting, only operate them in air long enough to verify that they operate then turn them off. Water cooling is required for extended operation of the light heads.

1 Upper Port Fwd	2 Joint control of 1 & 3	3 Upper Starboard Fwd
4 Lower Port Fwd	5 JKL	6 Lower Starboard Fwd
7 Port Side Light	8 Spot Light	9 Starboard Side Light
* PGRM	0 Aft Light	# ENT



The external lighting heads on the vLBV are individually controlled for both operation and brightness levels. Each light has 10 brightness settings, 1-10. 1 being the dimmest and 10 being the brightest.

To select the light to be controlled, press and hold the light button while pressing the number corresponding to the light you want to control.

Once the light/s is selected, press and release the **LIGHT** button again to turn on the selected lights.

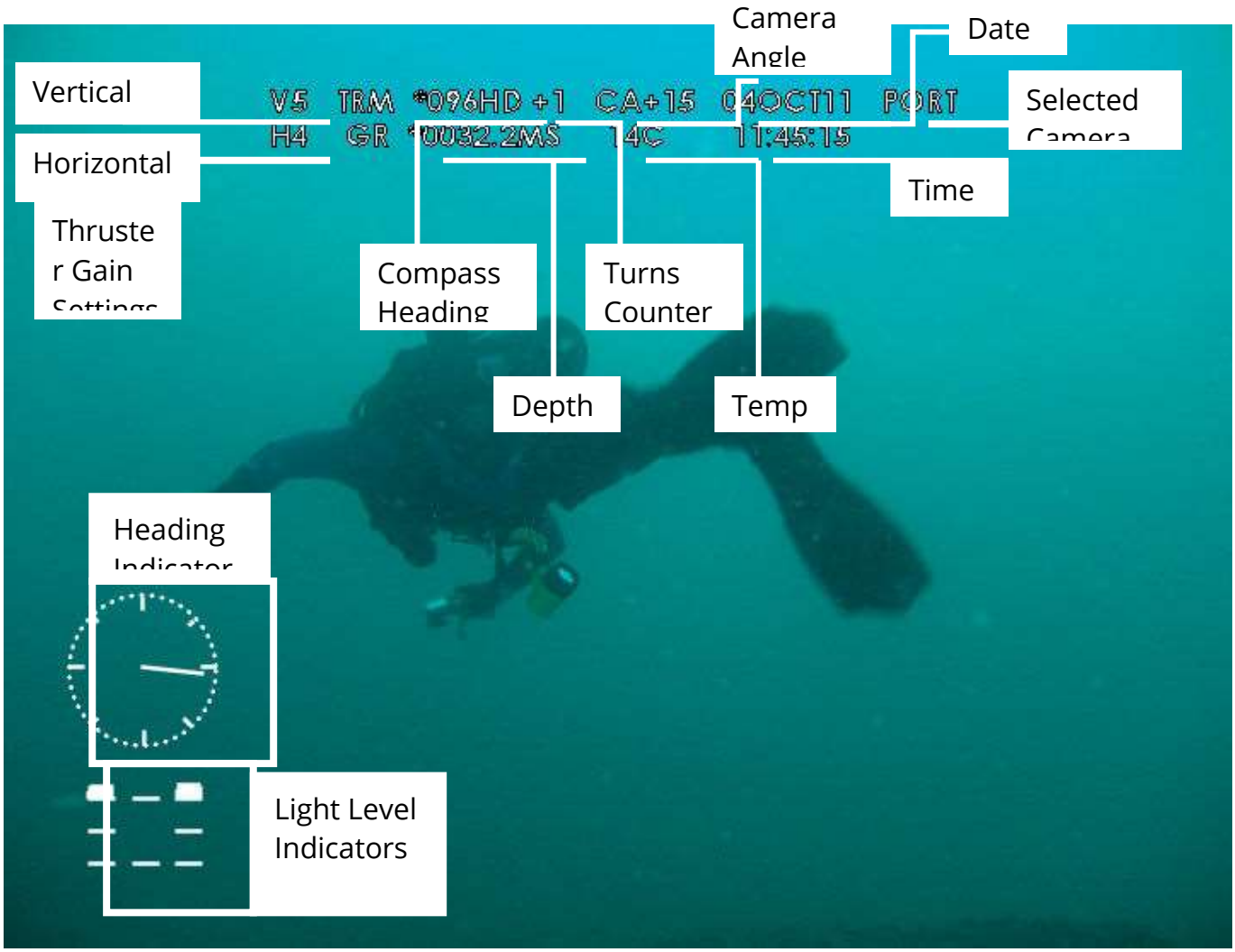
To increase or decrease the light level of the selected light, press the + or – buttons located above and below the LIGHT button.

To turn the selected light off, press and release the **LIGHT** button. When the selected light is turned back on, it will turn on at the level it was turned off at. i.e. If light selection 2 was at level 7 when turned off, it will turn back on at level 7.

1.4.4.4 Video Overlay

The video overlay displays information to assist the operator in the piloting and control of the vLBV.

Information displayed is: the vertical and horizontal thruster gain settings, the vLBV heading and turns counter, camera angle depth, and water temperature.



Depth can be displayed in metric or imperial measurement. The depth can also be set for operation and accurate reading for fresh or salt water. If depth output is set to metric, the temperature is displayed in Celsius. When depth is set to imperial the temperature is displayed in Fahrenheit.

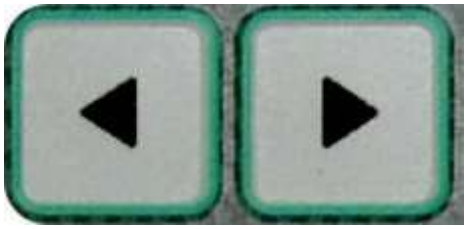
The default position for the video overlay is bottom. For ease of reading, it is displayed at the second alternative (top) position in this manual.
For additional information regarding the video overlay, refer to Section 2.2.

1.4.4.5 Accessories

Accessories refers to SeaBotix designed and installed equipment i.e. the Three Jaw Grabber.

The operator should press the select button on the operator control unit, cycle between all installed accessories, and verify operation.

For the Three Jaw Grabber, the left arrow button closes the jaws.



For the Three Jaw Grabber, the right arrow button opens the jaws.

1.4.4.6 Optional Sensors

Optional sensors: refers to third party equipment that was installed and integrated into the vLBV.

This would include devices like:

Scanning Sonar
Multi-Beam Sonar
Acoustic Tracking Systems
Echo Sounders/Altimeters
Thickness Gauges
Water Quality Probes etc…

Open the manufacturers' operational software, and verify operation of the device or devices.

Read the manufactures manual supplied with the system. Special attention should be paid to all safety notices to avoid damage to the equipment.

1.4.5 Disconnecting the System

NOTICE

Never attempt to disconnect any portion of the vLBV system while power is applied. Equipment damage will result.

A

Press the power button on the operator control unit.

B

Shut down the processor unit on the INC300

C

Turn off the power breaker on the INC300

D

Turn the power switch on the SPS3020EH to the off (down) position.

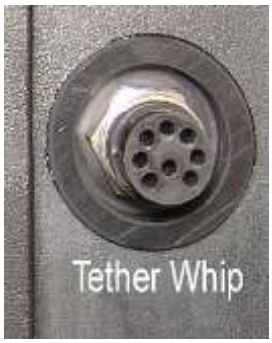
E

Unplug the power cable for the SPS3020EH and stow.

F

Unplug the CBA210 (interconnect cable) from the SPS3020EH to the INC300

G



Unplug the tether whip cable from the SPS3020EH

H

Place the OCU in the storage pocket of the lower panel assembly of the INC.

Rotate the locking tabs to secure the OCU.

Replace the protective foam insert close and latch the lid.

NOTICE

NOTE: The OCU is placed face down in the ICC, and face up in the INC.

J

Coil the tether whip on the whip storage posts on the Universal Reel System (URS).

K

Remove the handle from the reel frame, install in the center of the URS hub and prepare to recover the tether.

L

Disconnect the electrical 8 pin connector from the Electronics Bottle Assembly.

M

Spool the tether back onto the URS and set the reel lock.

1.5 Post Dive Inspection

After recovering the system, a visual inspection is recommended to check for debris, fouling or equipment damage that may have occurred during operation.

A. Check all thrusters for fouling or damage. Verify the propeller guard is undamaged, and that all 3 blades are present on the propeller.

B. Inspect the light heads for damage.

C. Check the oil compensation bladders on each of the 6 installed thrusters for damage, air bubbles, and proper oil fill level.

D. Inspect the frame for damage.

E. Inspect the grabber for damage missing hardware or fouling.

F. Inspect all installed sensors for damage or fouling

1.6 Calibrating the Compass

Calibration of the internal compass should be performed periodically. When changing geographic operating areas or when error in output is noted.

Refer to section 2.4.3.1 for the required procedures for compass calibration

1.7 Trimming the vLBV

The vLBV was trimmed at the factory for either 32 ppt salt water at 19C, or fresh water at 19C. This selection was made at the time of order.

Adjustment of the trim is required for your specific operating conditions. A properly trimmed system significantly eases operation.

If equipment is added or removed from the vLBV, the trim will have to be adjusted.

When trimming the vLBV you are adjusting it for neutral buoyancy and level trim. This means level side to side, and fore and aft.

To adjust the trim, set the vLBV with tether connected into water of the salinity and temperature that matches to operating area. There should be about 2 meters of tether in the water with the vLBV. If equipped with a grabber, the grabber needs to be extended to deployment position all accessories that will be utilized must be installed.

NOTE: The system does not need to be powered on for this operation.

1. Place the vLBV in water of approximately the same salinity and temperature as will be found at the operating location.

NOTE: If you are dockside or water c are relatively calm, the procedure car accomplished at the work site.

2. Check the trim of the vLBV by visually inspecting how the system sits in the water. If the vLBV sinks, weight will have to be removed, if the vLBV floats, check for level for and aft, side to side. Finally verify that it is close (+/- 6 grams) to neutral.

When properly trimmed, the system will float just at the surface of the water, and the addition of 1 SS fender washer provided in the trim kit will cause the vLBV to gently descend, and removal will allow it to surface.

NOTE: The blue dashed line indicates where the water level should be without any top mounted devices.

3. If additional weight is required, the weights are listed at the left for the stainless steel trim weights. The thinner supplied SS fender washers weigh 6 grams ea.

4. Place weights at the 4 corners of the vLBV till the proper trim is obtained.

The vLBV should be level fore to aft, side to side.

5. Once the ballast weight has been determined, mount the weights to the vLBV at the ballast mounting points on the four (4) corners of the lower section of the bumper frame then secure them with the wing nut.

1.8 vLBV Storage

Prior to storage, the vLBV should be rinsed and dried. Low pressure air can be used to speed the drying process.

All provided connector caps should be installed prior to storage.

1. Place the vLBV in the provided transit case.

2. Place the URS in the provided transit case.

3. Place the OCU joystick in the lower panel assembly of the INC rotate the retaining latches to hold the OCU in place, now place the foam protective pad over the OCU and Keypad then close the lid on the INC.

Store the system in a clean dry space.

NOTE: If the system is to be stored for more than 3 months, it is recommended that the 50 hour maintenance be performed prior to operation after storage to ensure adequate lubrication on the shaft seals for the thrusters.

Section 2 vLBV Controls

2.1 Operator Control Unit (OCU)

Joystick

Vertical thruster control knob

The Operator Control Unit controls all features of the vLBV.

The Horizontal movement of the vLBV is controlled by the joystick. The vertical movement is controlled by the vertical thruster control knob.

2.1.1 Power

The power button is used to turn the power on to the vLBV. Once selected, the red LED above the power button will light.

2.1.2 Numeric Keypad

The numeric keypad has several functions. It is used to select the displayed video camera, select the light head for control, set horizontal and vertical thruster gain settings, assessing and navigating the menus and entering text.

Numbers 1-9 also have assigned alpha characters for text entry.

2.1.3 Control of Horizontal Movement

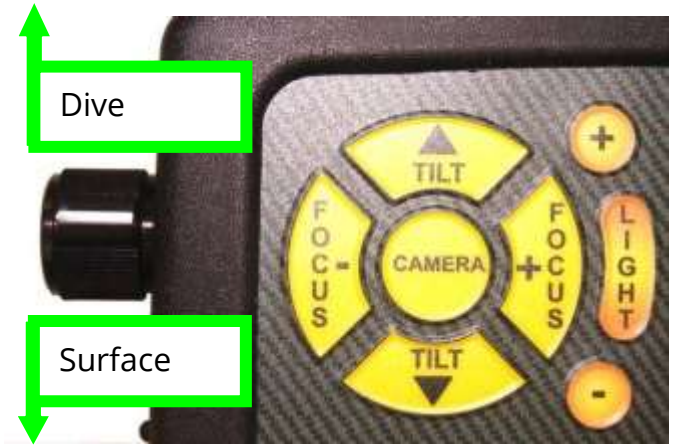
The joystick controls the 4 horizontal plane thrusters. Movement of the vLBV mirrors the controls: push the joystick left to move left, push forward to move forward, etc.

2.1.4 Turning the vLBV

Rotation of the top portion of the joystick causes the vLBV to turn in the same direction as the knob is rotated.

Rotate anti-clockwise = Turn to port

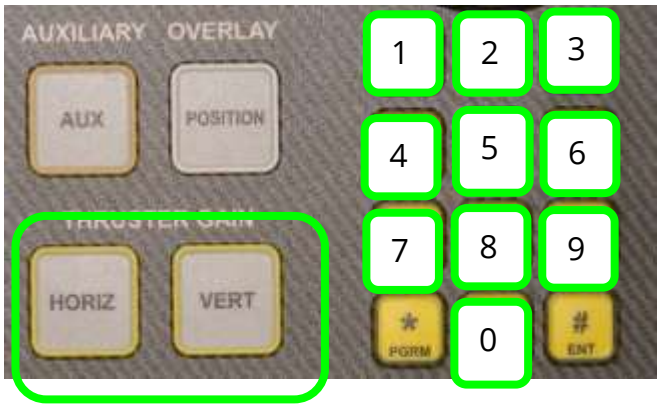
Rotate clockwise = Turn to starboard



2.1.5 Vertical Thruster Control

The vertical thruster control knob is located on the left side of the OCU. The default control settings are: rotation of the knob forward will drive the vLBV down (dive), and turning the knob towards the operator will drive the vLBV upwards (surface).

NOTE: This control is not spring return to center, so the operator must manually return it to the center position to stop the vertical thrusters.



2.1.6 Thruster Gain Control

The vLBV thrusters have 10 gain settings (1-0) that are user selectable. The default setting for both horizontal and vertical is Gain 5 when the vLBV is powered on.

To change the level, press and hold either the HORIZ or VERT button and press the new value 1-0.

1=10%...5=50%...0=100%

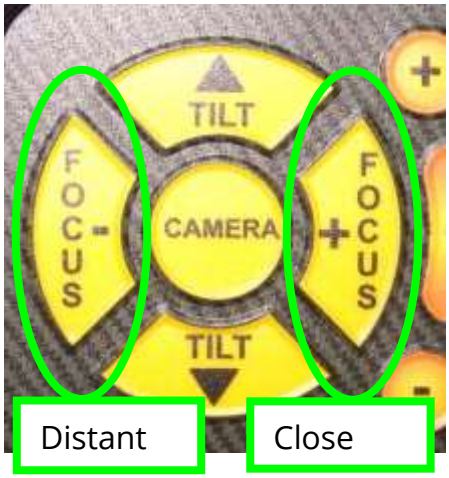
2.1.7 Camera Selection

If multiple cameras are installed, the process for selecting the displayed camera is to press and hold the camera button while selecting the number of the desired camera.

2= Bow (Primary) Camera
5= Zoom Camera (Bow Secondary)
7= Port Camera
9= Starboard Camera
0= Aft Camera

Default display camera on vLBV power up is Camera Selection 2 (the primary camera.)

All other camera positions are upgrade options.



2.1.8 Focus Controls

To adjust the camera focus, press the FOCUS + button to adjust for close objects, press the FOCUS - to adjust for distant objects.

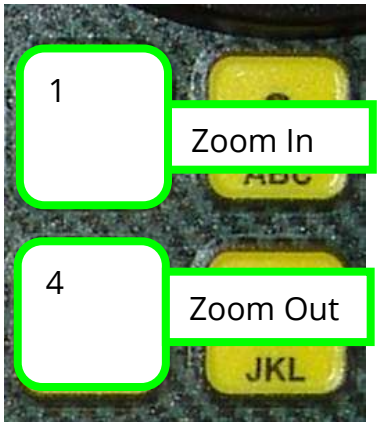
NOTE: This option will only be available for cameras with variable focus.

To return to Auto Focus, Press the **AUX** key and the **1** key simultaneously on the keypad.

2.1.9 Camera Tilt Control

Only the forward mounted camera or cameras have tilt control. The factory default setting is operation of the tilt arrow pointing away from the operator will tilt the camera down, and operation of the arrow pointed towards the operator will tilt the camera up.

Arc of travel for the camera is +90 degrees up and -90 degrees down



2.1.10 Zoom Control

For cameras with variable zoom, control of the zoom function is via the numeric keypad.

The operator first selects the camera with zoom capability as the active camera following the procedure outlined in 2.1.7

Then use the number 1 key to zoom in.

Use the number 4 key to zoom out.

2.1.11 Lighting Control

The external lighting heads on the vLBV are individually controlled for both operation and brightness levels. Each light has 10 brightness settings, 1-10. 1 being the dimmest and 10 being the brightest.

1 Upper Port Fwd	2 Joint control of 1 & 3	3 Upper Starboard Fwd
4 Lower Port Fwd	5 JKL	6 Lower Starboard Fwd
7 Port Side Light	8 Spot Light	9 Starboard Side Light
* PGRM	0 Aft Light	# ENT

To select the light to be controlled, press and hold the LIGHT button while pressing the number corresponding to the light you want to control.

Once the light/s is selected, press the **LIGHT** button to turn on the selected lights.

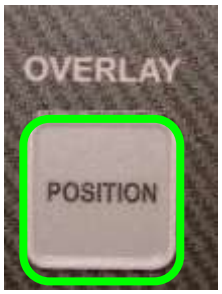
To increase or decrease the light level of the selected light, press the + or – buttons located above and below the LIGHT button.

To turn the selected light off, press the **LIGHT** button. When the selected light is turned back on, it will turn on at the level it was turned off at. i.e. If light selection 2 was at level 7 when turned off, it will turn back on at level 7.

2.1.12 Accessory Control

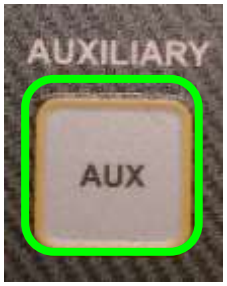
To select a device, press the select button on the OCU, the overlay will display the abbreviation for the selected device. The operator then uses the right and left triangle buttons to control the device.

NOTE: Sonar's and other sensor devices are not accessories, they are Optional Sensors.



2.1.13 Overlay Position Control

The default display position for the video overlay information is bottom center of the video. By pressing the POSITION button the operator can move it to the top of the display or turn it off. Each press of the POSITION button will cycle the overlay to the next display position.



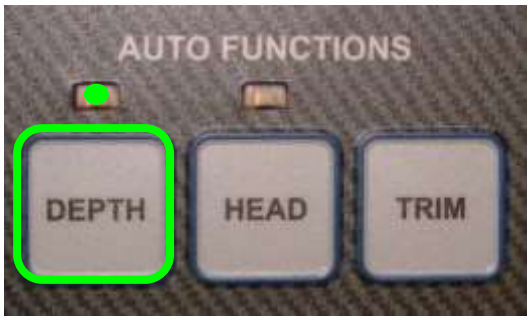
2.1.14 AUX Controls

The AUX button is used for re-enabling the auto focus option for cameras with that option. Press and hold the AUX button and select the number 1 on the keypad.

2.1.15 Auto Functions

Included in the controls are three auto functions that when enabled by the operator, give primary control of that function over to the Motherboard inside the electronics bottle of the vLBV.

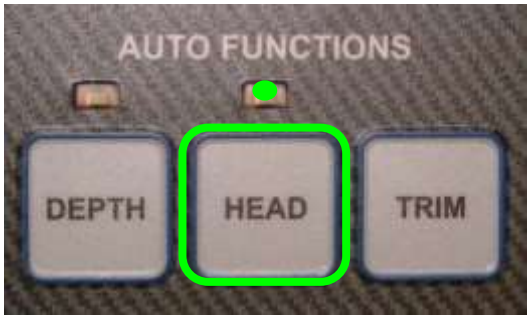
2.1.15.1 Auto Depth



Auto Depth is used to hold the vLBV at a desired depth. The operator maneuvers the vLBV to the desired depth, and presses the DEPTH button to engage the feature.

When enabled, the green LED above the depth button will light, and asterisk will display on the video overlay to the left of the vLBV depth.

2.1.15.2 Auto Heading



Auto heading is used to hold the vLBV on a desired compass heading. The operator turns the vLBV to the desired heading and presses the HEAD button to engage the feature.

Control can be overiden by the operator, by rotating the knob at the top of the joystick and the system will automatically lock to the corrected heading.

When enabled, the green LED above the HEAD button will light, and asterisk will display on the video overlay to the left of the vLBV heading.

	Note: When Auto Heading is enabled, the system will reserve power from the horizontal thrusters to control heading. If conditions require full power for operation it is not recommended that auto heading be utilized.

2.1.15.3 Auto Trim

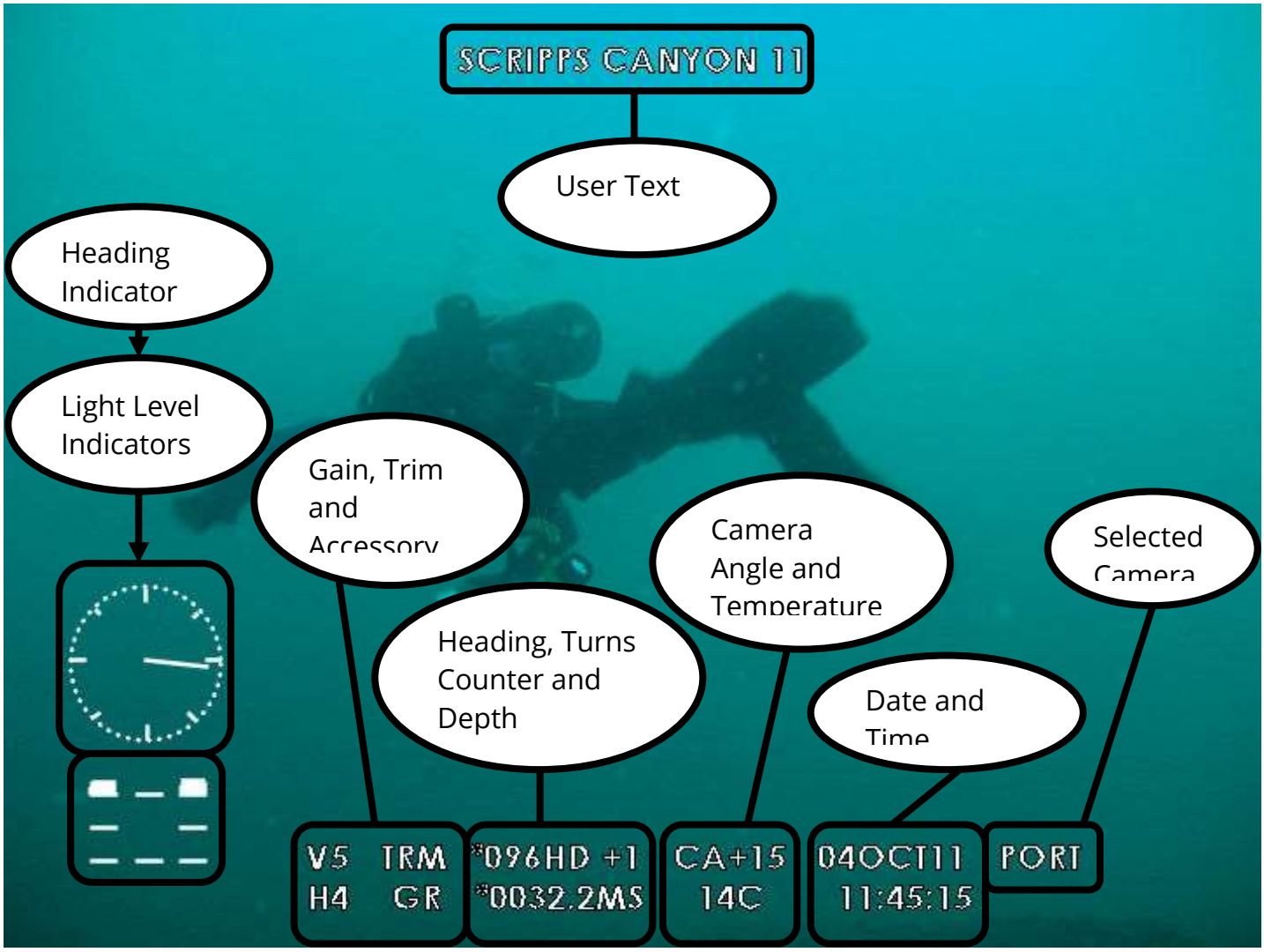
The TRIM button operates much like cruise control. The operator sets the speed of the vLBV using the Joystick and Vertical thruster control knob. The operator presses the TRIM button and the system then maintains those thruster settings once the joystick is released, and the Vertical Thruster Control Knob is returned to center.

When selected, the letters TRM will display on the top line of the video overlay to the right of the vertical thruster gain setting.

2.2 Video Overlay

Video overlay is a series of alphanumeric characters embedded into the video stream from the vLBV that displays the operating parameters.

The vLBV overlay data is displayed by default at the bottom of the screen. The operator can change the position by pressing the POSITION button on the OCU.



2.2.1 User Text

By following the instructions in Section 2.3.3, the operator can enter up to 17 alphanumeric characters that will be displayed on the video at all times.

No special characters (&, *, %, $..) are implemented at this time.

2.2.2 Gain Control, Trim and Light Level Indicator

Vertical Thruster Gain: A numeric value from 1-0 will be displayed after the V to indicate the current gain setting. 1=10%, 2=20%...0=100%

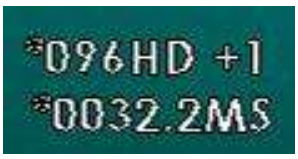
Horizontal Thruster Gain displayed after the H to indicate the current gain **Thruster Gain:** A numeric value from 1-0 will be setting. 1=10%, 2=20%...0=100%

Trim (TRM): This setting indicates that the operator has set the thrusters to operate at the last position of the joystick and vertical thruster control knob. When selected, this function operates like cruise control for an automobile. The overlay displays this as a reminder for the operator that the function is enabled.

Selected Accessory: When the operator selects an accessory to control via the OCU, the overlay will display the selected component. In this case, the Three Jaw Grabber is selected (GR).

2.2.3 Heading and Depth

Heading: This portion of the overlay displays two pieces of information. The compass heading of the vLBV and the number of full turns that the vehicle has made. A value proceeded by the minus sign (-) indicates turns anti-clockwise. If the value is preceded by a positive (+) sign, the turns are clockwise.



Depth: Depth can be displayed in one of four measurements.

MS=Meters of Saltwater	**FS**=Feet of Saltwater
MF=Meters of Freshwater	**FF**=Feet of Freshwater

Because each water type has its own density, the operator should make sure that this is properly set to ensure accurate depth readings.
Refer to Section 2.3.3.2 for instructions on changing the measurement.

2.2.4 Camera Angle and Temperature

Camera Angle: Camera angle is displayed as a positive or negative value

from +90 to -90. Positive values are looking up and negative values are looking down.

Water Temperature: Water temperature is displayed in either Celsius or Fahrenheit. The scale is determined by the depth measurement setting. If depth is set to feet, the temperature is displayed in Fahrenheit, if depth is set to Meters, then the temperature is displayed in Celsius.

2.2.5 Date and Time

Date: The date is displayed in the international format of DDMMMYY

Time: The time is displayed as a 24 hour clock. HH:MM:SS

2.2.6 Selected Camera

Primary navigation camera, selection 2 on the keypad. Default camera on power up of vLBV.	BOW
Zoom Camera, normally mounted forward, selection 5 on the keypad.	ZOOM:
Port side looking camera, selection 7 on the keypad.	PORT:
Starboard side looking camera, selection 9 on the keypad.	STBD:
Aft facing camera, selection 0 on the keypad.	AFT:

2.3 Menus

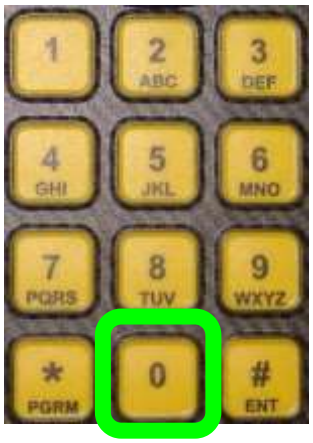
The menus allow the operator to select, display and control all of the standard features of the vLBV.

2.3.1 Quick Access Menu

The Quick Access Menu is the entry point for all other menus.

To access the Quick Access Menu screen press the PRGM key on the numeric keypad of the OCU.

The video overlay will now display the Quick Access Menu option screen.



Press the 0 button to continue

2.3.2 Main Menu

In the Main Menu, the operator has four selections.

1. Setup

2. Calibrate

3. Diagnostics

4. Options

Select the corresponding number on the keypad.

2.3.3 Setup menu

The Setup Menu allows the operator to:

A. Set date and time

B. Change units of measurement and water type

C. Enter user text

D. Reset to default

2.3.3.1 Date/Time

Adjusting the date and time allows the operator to synchronize the system clock in the vLBV to local time, or to a master time clock used for controlling operations.

1.) DATE/TIME

When menu option one is selected from the Setup Menu screen, the operator is prompted to set the date then the time for the vLBV.

The operator is first prompted to enter the numeric value for the date.

After adjusting the value, or if no adjustments are needed, the operator can press the ENT button on the numeric keypad to save the changes.

The month is entered as a numeric value. (ex. 1 for January, 12 for December).

This process is repeated for the year, hours, minutes and seconds.

2.3.3.2 Units/Water Type

2.) UNITS/WATER TYPE

When this menu option is selected from the Setup Menu, the operator is prompted to set the unit (meters/Feet) for depth display as well as the water type.

1. MF Meters of Freshwater
2. MS Meters of Saltwater
3. FF IMP (Feet) Freshwater
4. **FS** IMP (Feet) Saltwater

The designator MF, MS, FF, or FS will display to the right of the depth reading on the bottom line of the video overlay.

2.3.3.3 User Text

3.) USER TEXT

When User Text is selected from the Setup Menu the operator enters alphanumeric characters to display on the video overlay.

Each character is entered individually, and the ENT key must be pressed to proceed to the next character. To add a space, press the enter key twice after the last character.

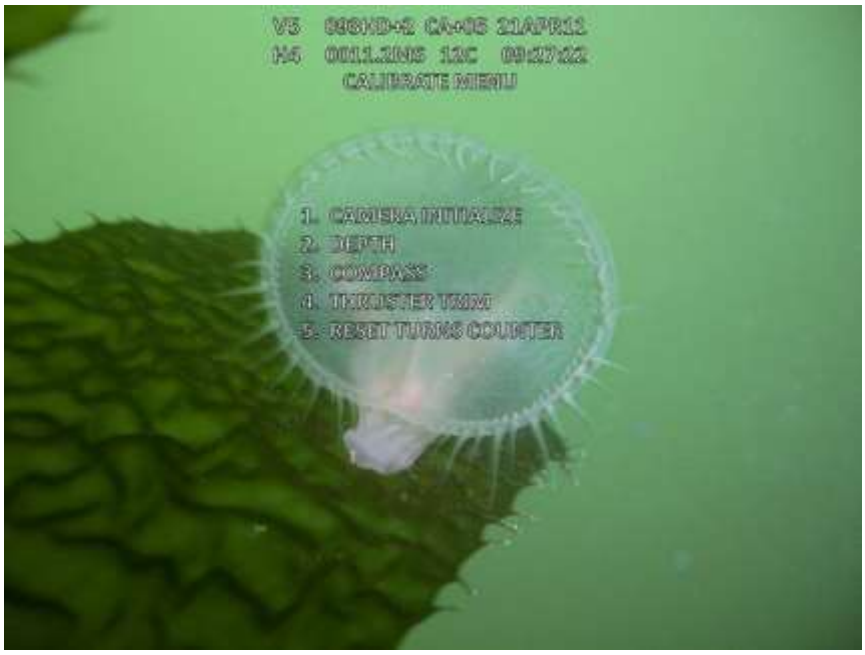
No special characters (*, #, $) are available
This information will be displayed at all times until the operator turns the feature off by selecting user text again, pressing the enter key, then exiting the menu.

2.3.3.4 Reset to Default

The reset to default selection is used to reset all date, time and user text to the default settings.

The system Date and Time will be set to the value in the program and the User Text will be erased.

2.3.4 Calibrate Menu



CALIBRATE

When this option is selected from the main menu the system will display the CALIBRATION which allows the operator to perform calibrations on the standard vLBV sensors.

1. Camera Initialize
2. Depth
3. Compass
4. Thruster Trim
5. Reset turns counter

1. Camera Initialize: When selected, the camera will drive to the maximum up angle (+90 degrees), set the angle, then return to zero for operation. This feature calibrates the tilt angle indicator for the primary camera.

2. Depth:

The calibration options for depth are:

1. Set Depth
2. Set to Zero

1. Set Depth: This option is used to calibrate the depth sensor to a known depth. When operating in an area with a known depth, the vLBV depth can be adjusted to display the measured depth.

2. Set to Zero: This option should be used when the vLBV is on the surface prior to each deployment.

2.3.4.1 Compass Calibration

Compass Calibration offers many options.

1. Compass Parameters
2. Set Declination
3. Enable Soft Iron
4. Disable Soft Iron
5. Start Soft Iron
6. Start Hard Iron
7. Start Hard Iron Z
8. End Calibration

Compass Parameters allow the operator to enter the discrete compass parameters.

NOTICE

This feature should only be accessed by factory trained personnel as changes in this information will affect the accuracy of the compass.

Set Declination allows the operator to enter the positive or negative magnetic correction for local operations.

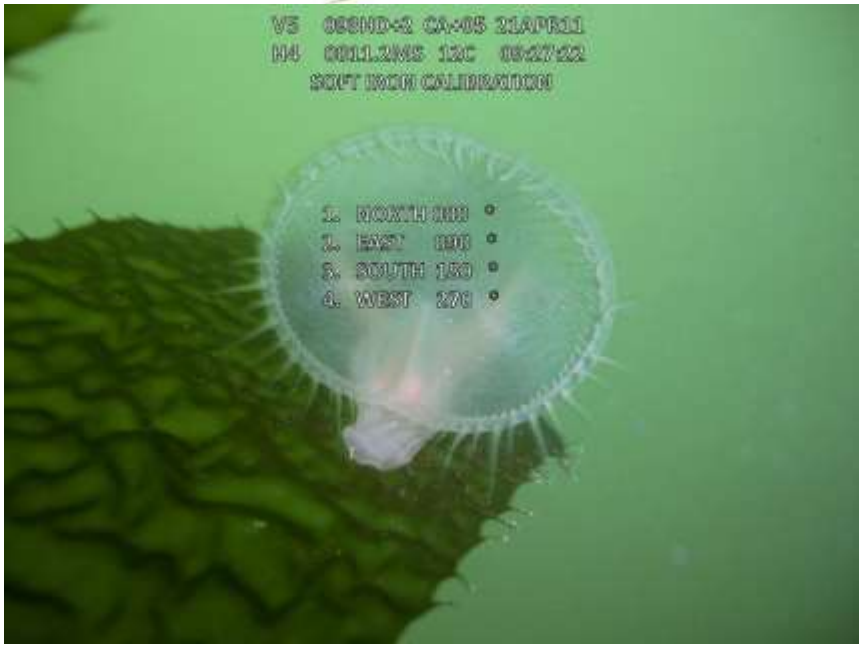
This allows the operator to link the compass information to true north.

To enter the negative sign (-), press the 0 numeric key on the hand controller prior to entering the numbers for declination. Leading zeros are not to be entered. Once the entry is complete, press the ENT key to complete the entry.

Enable Soft Iron, allows the operator to set the Soft Iron Calibration as the main compass calibration.

Once selected, an asterisk will appear to the right of the entry.

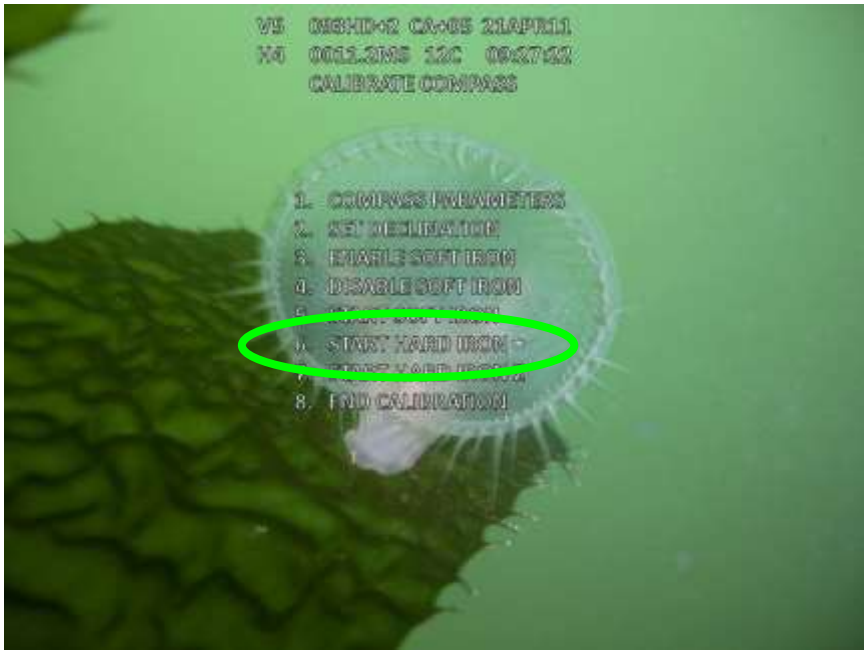
Disable Soft Iron calibration returns the compass calibration to the hard iron calibration. This is the most accurate and preferred calibration for the vLBV.



Start Soft Iron

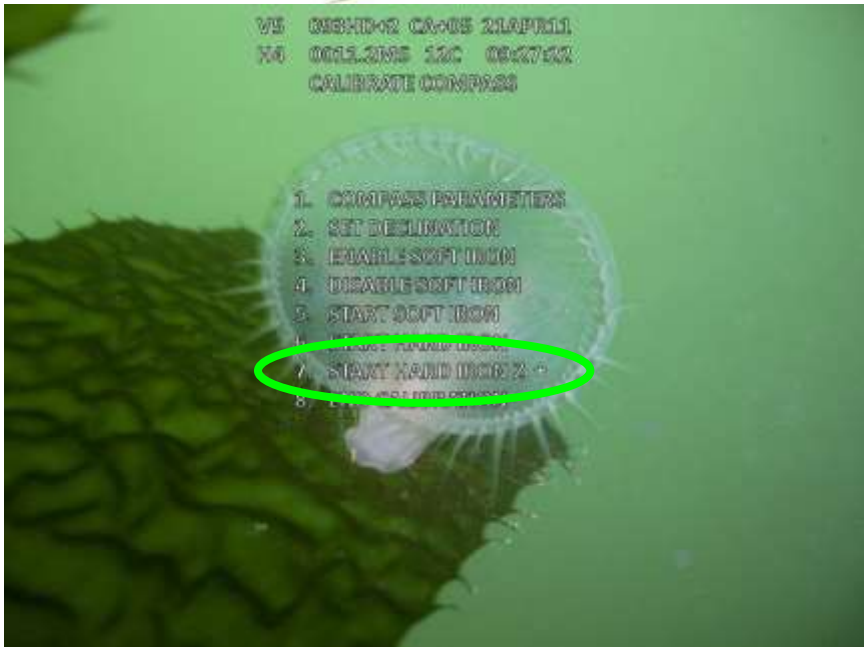
This feature requires that the operator turn the vLBV to the four primary compass points, (north, east, south and west) and press the corresponding numeric value (1-4) followed by the ENT key at each point.

Once the ENT key is pressed for each point an asterisk will display to the right of the compass point in the overlay.



Start Hard Iron is used to calibrate the horizontal axis compass. Once selected an asterisk will appear at the right of the selection, the operator then rotates the vLBV 360 degrees while maintaining a level horizontal attitude.

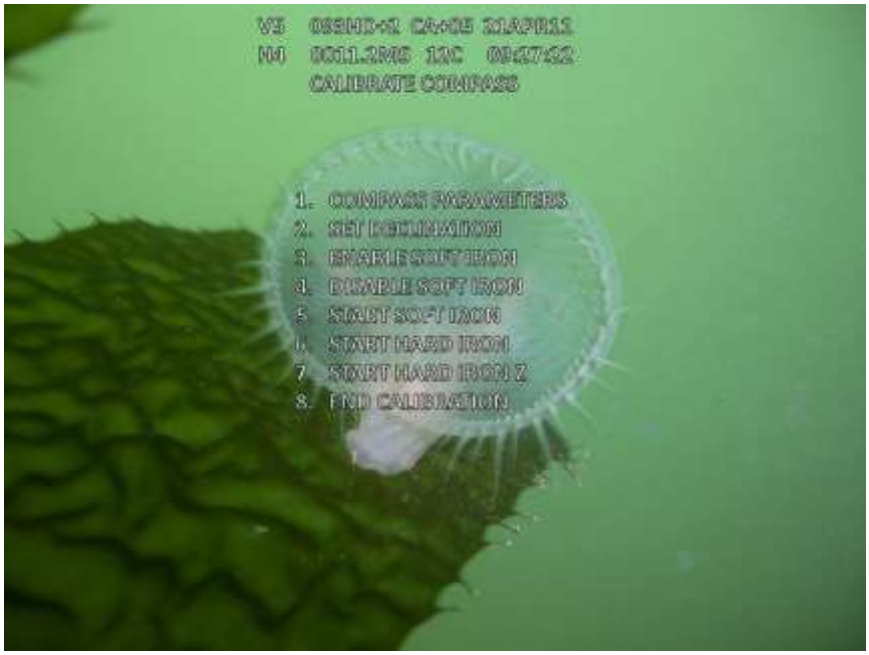
The rotation should be performed very slowly and should take approximately 2 minutes to complete the 360 degree revolution.



Hard Iron Z calibration requires that the operator place the vLBV on its vertical axis forward end down, and perform the same 360 degree horizontal rotation to calibrate the Z axis of the compass.

vLBV position for Hard Iron Z calibration.

Press 8. END CALIBRATION when complete



Once the calibration operation is complete, the operator will press End Calibration on the Keypad, to exit this menu.

2.3.4.2 Thruster Trim

The **Thruster Trim** feature allows the operator to individually adjust the gain level of each horizontal thruster. This feature can be used to compensate for the drag caused by flying the vLBV with an externally mounted attachment.

For example, while flying with a grabber mounted to the starboard side of the vehicle, the vehicle will naturally rotate to starboard. Using the thruster trim feature allows the operator to reduce the speeds of the port thrusters and compensate for the drag effect of the grabber.

To do this, the operator can set the gain values for each port thruster on a scale ranging from -100 to +100. A value of +50 will cause the port thrusters to operate at half gain. A value of -50 will cause the port thrusters to rotate backwards at half gain.

NOTICE

These settings should only be adjusted by an experienced operator. Incorrect settings can cause the vLBV to operate opposite the operators intentions, and could result in damage to or loss of the vehicle.

NOTICE

SeaBotix recommends that the operator only adjust the rotate portions of this menu to assist the operator in controlling the turn rate of the vLBV.

The operator first selects the desired direction for adjustment using the numeric keypad on the Operator Control Unit.

1. Lateral to Port
2. Lateral to Stbd
3. Longitudinal to Aft
4. Longitudinal to Fwd
5. Rotate to Port
6. Rotate to Stbd

Here we have selected Lateral to Port.

The operator then selects the specific thruster for trim adjustment.

1. Port Fore
2. Port Aft
3. Stbd Fore
4. Stbd Aft

To enter a value, use the numeric keypad on the Operator Control Unit.

To set a negative value, the operator enters 0 on the keypad, then type the new value followed by the ENT (enter) key.

This step will be performed for each thruster to be adjusted.

Changing the rotation will require the same operations, with the operator adjusting each thruster.

1. Port Fore
2. Port Aft
3. Stbd Fore
4. Stbd Aft

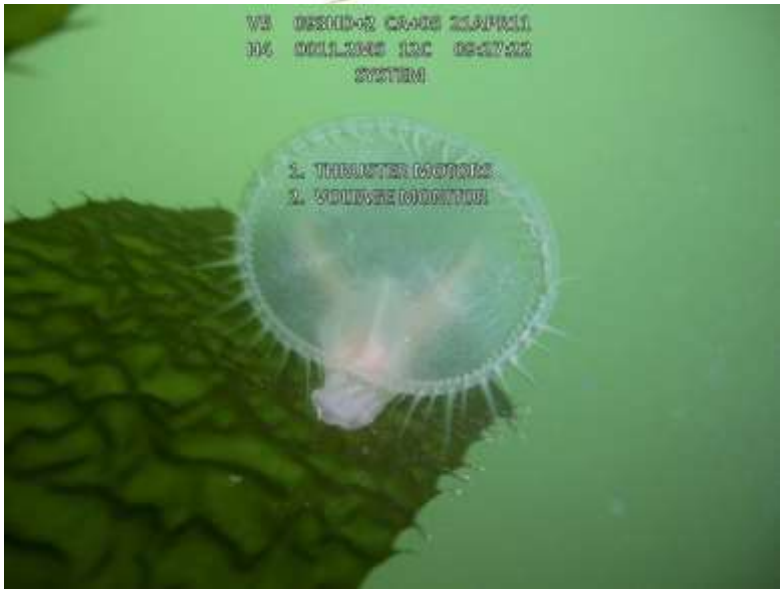
If the vLBV is heeling to port, the operator should adjust the starboard thrusters to a lower setting for Longitudinal To Port and leave the Port thrusters at the normal value.

2.3.5 Diagnostics Menu

Allows the operator to select and review status monitors for the vLBV

2.3.5.1 System

The **Diagnostics System** menu allows the operator to review each thruster status, and the voltage output levels for each power supply.

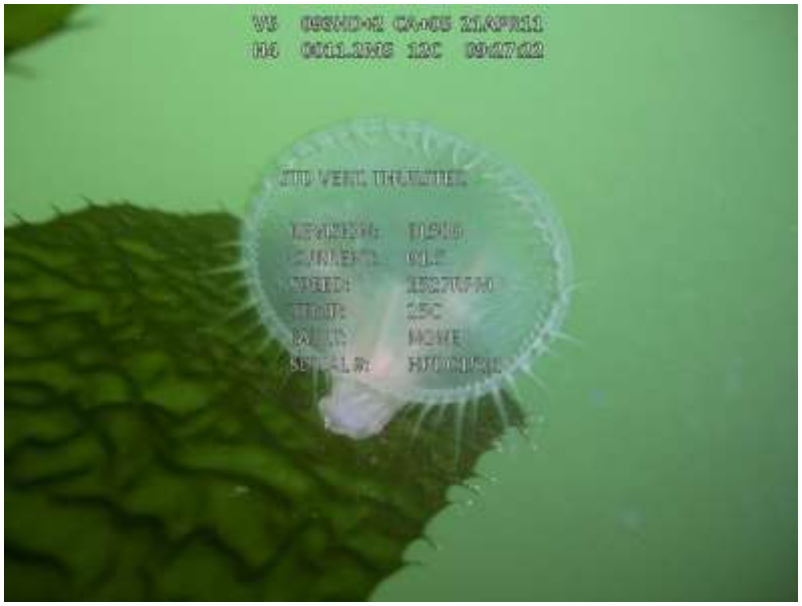


Once the **System** menu has been selected, the operator may now choose from the following selection.

1. Thruster Motors
2. Voltage Monitor

Selecting Thruster Motors will display the options available to monitor each thruster.

1. Port Forward
2. Port Aft
3. Port Vertical
4. Starboard Forward
5. Starboard Aft
6. Starboard Vertical



As each thruster is selected, the system will display the following information.

Revision:	Motor controller software version.
Current:	Thruster current draw
Speed:	RPM of the thruster.
Temp:	Temperature inside the thruster housing.
Fault:	Fault status reported by the controller board.
Serial #:	Serial number programmed for the thruster motor controller board.

When **Voltage Monitor** is selected, the system will display the voltage measurements from each of the power supply circuits.

2.3.5.2 Software Version

This displays the software version level of each portion of the system.

Once selected, the system will display the first page of the software versions.

Selecting option 1 will display the next page of software information.

1.	Next Page
OCU VERSION	This displays the Operator Control Unit firmware version
VCP VERSION	Vehicle Control Processor firmware
VCP BOOT REV	Vehicle Control Processor boot loader revision
VCP EIOP VER	Vehicle Control Processor Ethernet IO Processor firmware
VCP EIOP BOOT REV	Vehicle Control Processor Ethernet IO Processor boot loader revision

When **Next Page** is selected the system will then display the Navigation processor software revision page.

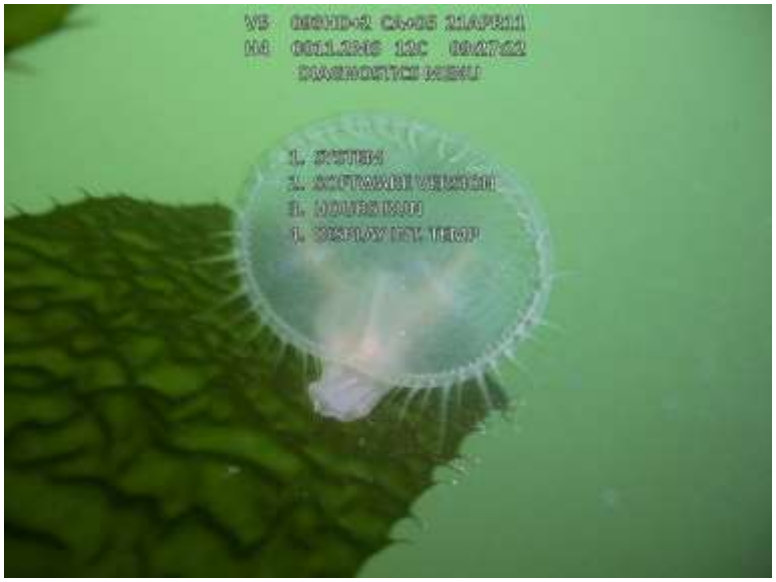
NAV VERSION	NAV board firmware version
NAV BOOT REV	NAV board boot loader revision.
NAV EIOP VER	NAV Board Ethernet IO Processer firmware version.
NAV EIOP BOOT LOADER REV	NAV board Ethernet IO Processor firmware version.
COMPASS REV	Compass board firmware version.
IO CONN REV	IO Controller board firmware version.

2.3.5.3 Hours Run

When **Hours Run** is selected from the **Diagnostics Menu**

The counter displays the total time that the system has been turned on it does not differentiate between operational and non-operational hours.

2.3.5.4 Display Int. Temp



To display the internal temperature of the electronics bottle of the vLBV, the operator selects item four (**4**) from the **Diagnostics Menu.**

Once selected the system will display the temperature from the processor board in the electronics bottle of the vLBV.

When internal temp is being displayed, the overlay will display an asterisk to the left of the temperature.

Once the operator navigates away from this menu option, the display will return to the external temperature.

2.3.5.5 Options Menu

The **Options Menu** is accessed from the **Main Menu**: It allows the operator to select and adjust the operation of four options for the vLBV.

1. Audio Channel 1
2. Audio Channel 2
3. Camera Tilt
4. Vertical Thrust

Selecting Audio Channel 1 or 2 gives the operator access to the input selection for the Audio Channels.

Once the operator has made a selection, an asterisk will display next to the activated selection.

At this time, the audio channels are not enabled.

Selecting Tilt Direction allows the operator to control the direction of the camera tilt function.

Normal is the default setting for the vLBV.

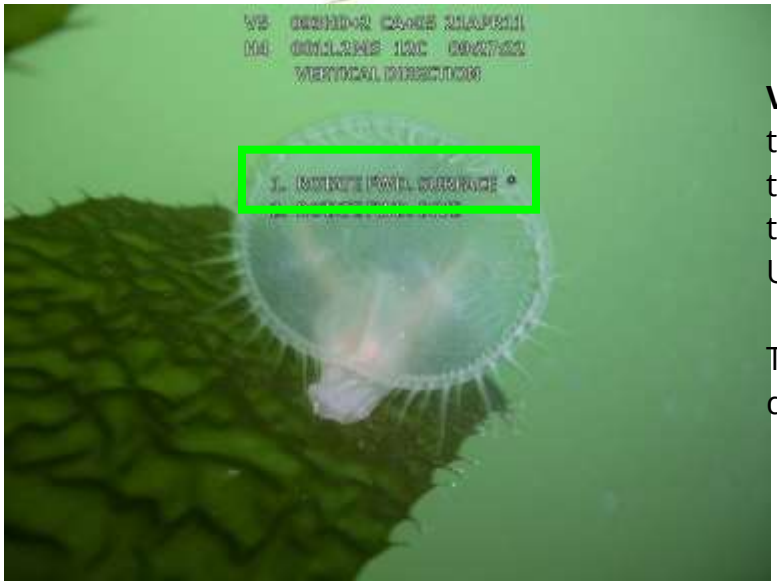
Normal Down

Inverted Up

Up

Down

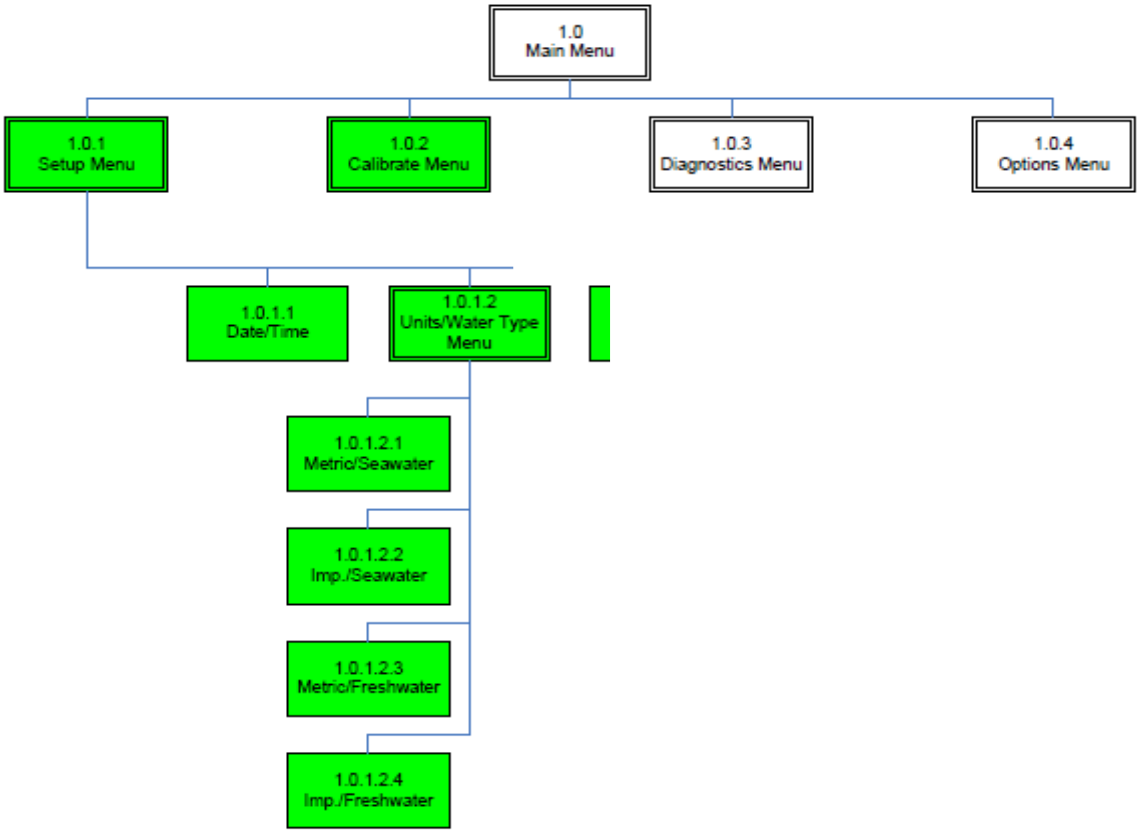
An asterisk will display to the right of the selection.

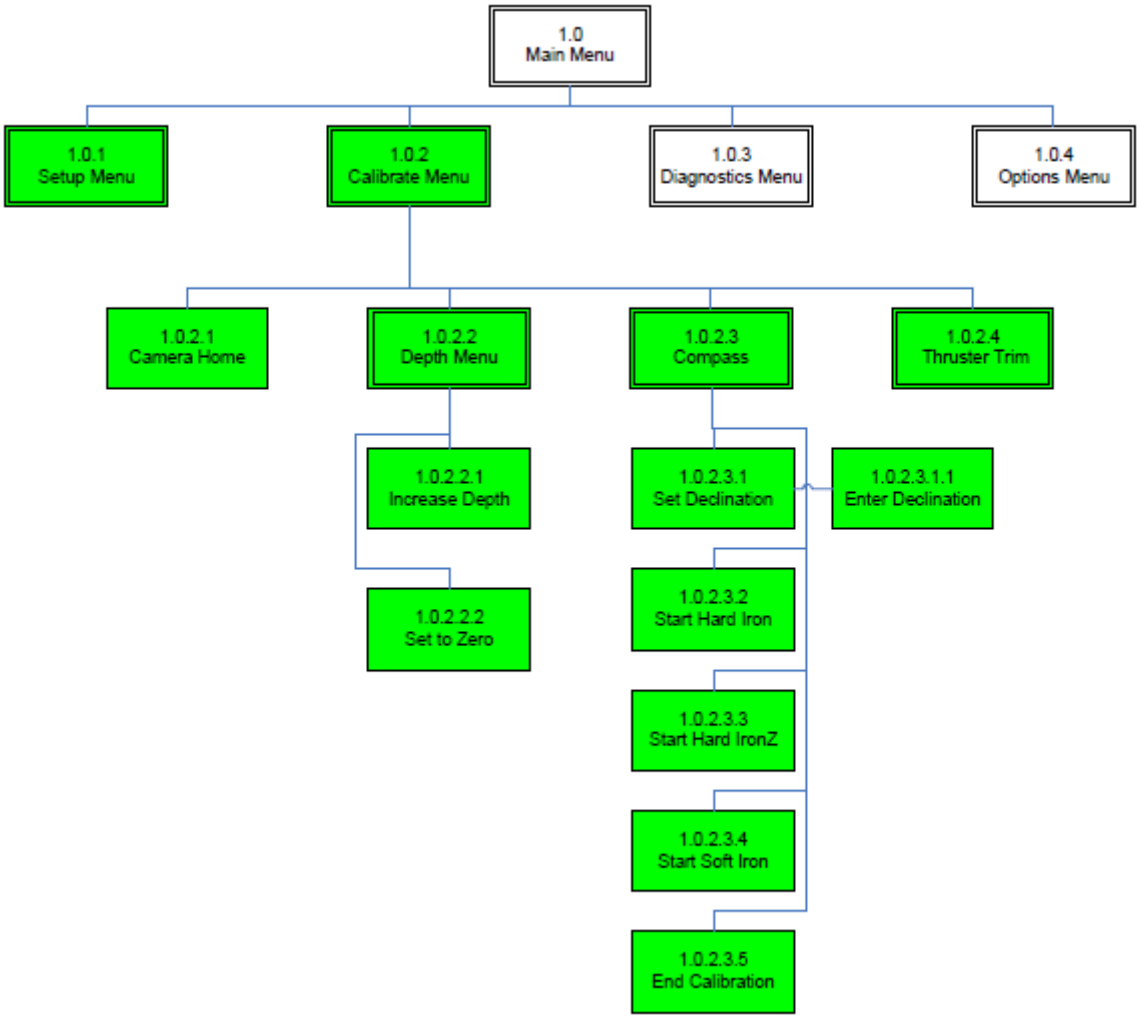


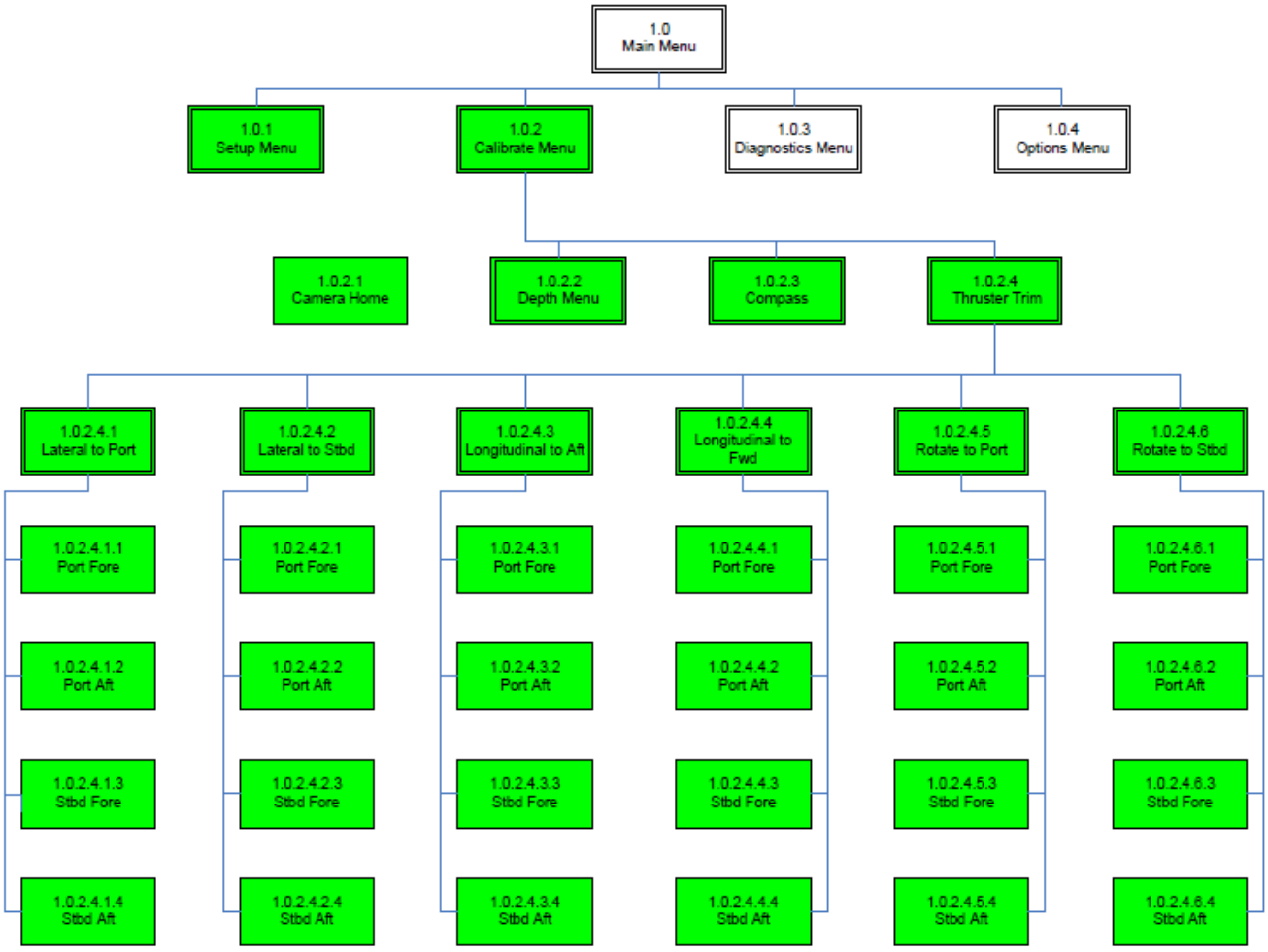
Vertical Direction allows the operator to set the dive/surface operation of the Vertical Thruster Control Knob on the left side of the Operator Control Unit.

The default setting is rotate forward to dive.

2.4 Menu Tree




1.0
Main Menu
1.0.1
Setup Menu
1.0.2
Calibrate Menu
1.0.3
Diagnostics Menu
1.0.4
Options Menu
1.0.2.1
Camera Home
1.0.2.2
Depth Menu
1.0.2.3
Compass
1.0.2.4
Thruster Trim
1.0.2.2.1
Increase Depth
1.0.2.2.2
Set to Zero
1.0.2.3.1
Set Declination
1.0.2.3.1.1
Enter Declination
1.0.2.3.2
Start Hard Iron
1.0.2.3.3
Start Hard IronZ
1.0.2.3.4
Start Soft Iron
1.0.2.3.5
End Calibration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Setup Menu
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Calibrate Menu
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Diagnostics Menu
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Options Menu
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Camera Home
1.0.2.2
Depth Menu
1.0.2.3
Compass
1.0.2.4
Thruster Trim
1.0.2.4.1
Lateral to Port
1.0.2.4.2
Lateral to Stbd
1.0.2.4.3
Longitudinal to Aft
1.0.2.4.4
Longitudinal to Fwd
1.0.2.4.5
Rotate to Port
1.0.2.4.6
Rotate to Stbd
1.0.2.4.1.1
Port Fore
1.0.2.4.1.2
Port Aft
1.0.2.4.1.3
Stbd Fore
1.0.2.4.1.4
Stbd Aft
1.0.2.4.2.1
Port Fore
1.0.2.4.2.2
Port Aft
1.0.2.4.2.3
Stbd Fore
1.0.2.4.2.4
Stbd Aft
1.0.2.4.3.1
Port Fore
1.0.2.4.3.2
Port Aft
1.0.2.4.3.3
Stbd Fore
1.0.2.4.3.4
Stbd Aft
1.0.2.4.4.1
Port Fore
1.0.2.4.4.2
Port Aft
1.0.2.4.4.3
Stbd Fore
1.0.2.4.4.4
Stbd Aft
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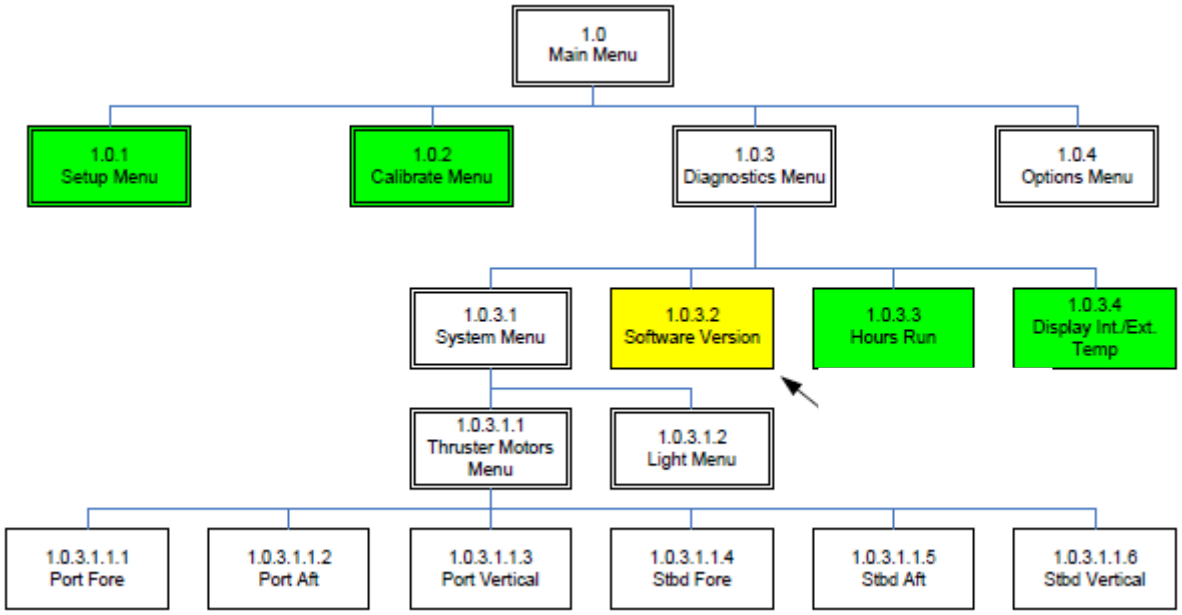
Port Fore
1.0.2.4.5.2
Port Aft
1.0.2.4.5.3
Stbd Fore
1.0.2.4.5.4
Stbd Aft
1.0.2.4.6.1
Port Fore
1.0.2.4.6.2
Port Aft
1.0.2.4.6.3
Stbd Fore
1.0.2.4.6.4
Stbd Aft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Main Menu
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Setup Menu
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Calibrate Menu
1.0.3
Diagnostics Menu
1.0.4
Options Menu
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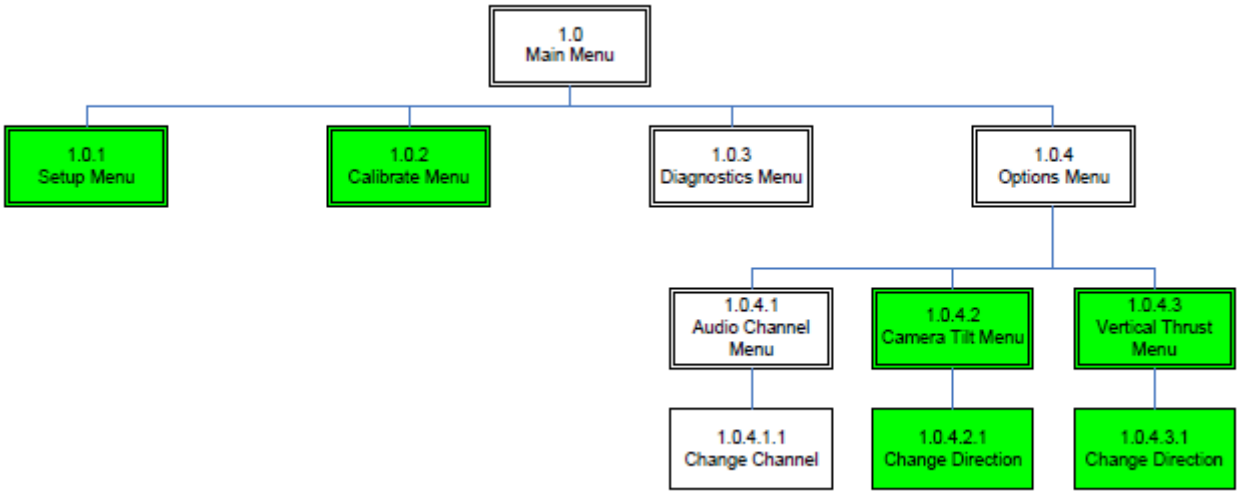
Port Fore
1.0.3.1.1.2
Port Aft
1.0.3.1.1.3
Port Vertical
1.0.3.1.1.4
Stbd Fore
1.0.3.1.1.5
Stbd Aft
1.0.3.1.1.6
Stbd Vertical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Main Menu
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Setup Menu
1.0.2
Calibrate Menu
1.0.3
Diagnostics Menu
1.0.4
Options Menu
1.0.4.1
Audio Channel
Menu
1.0.4.2
Camera Tilt Menu
1.0.4.3
Vertical Thrust
Menu
1.0.4.1.1
Change Channel
1.0.4.2.1
Change Direction
1.0.4.3.1
Change Direction

Section 3 Operating the vLBV

Operation of the vLBV was designed to be simple and intuitive. Operator controls are consolidated to simplify the controller design and ease operation.

The joystick controls horizontal movement and the vertical thruster control knob controls vertical movement. Camera controls were positioned so that the left hand can quickly move from the vertical thruster control knob and back. The majority of operator input will be controlled with the right hand, so even the accessory controls were designed to be operated with the left hand.

To surface or dive the vLBV, rotate the vertical thruster control knob in the desired direction.

To drive the vLBV, move the joystick in the desired direction of travel.

To turn the vehicle, rotate the knob at the top of the joystick in the direction required.

Remember that all thruster controls are proportional, the further the control is moved, the faster the vLBV moves on that axis.

The inclusion of auto features such as Depth, Heading, and Trim allow the operator to select these features and monitor the video, taking control of the vehicle only as needed.

3.1 Operating Environment

When possible, a quiet, traffic free operating environment allows the pilot to concentrate on the task at hand while minimizing distractions.

If it is necessary to operate in an area with spectators, a simple boundary will suffice to keep distractions to a minimum. In this type of environment, consider adding one additional individual whose task is to prevent interference by fielding questions and running interference.

Set up the equipment in a fashion that maximizes comfort. This can be done by utilizing the transit cases for the equipment. The ICC/INC can be set on top of the vLBV transit case and the transit case for the URS can serve as the seat for the operator. This places the equipment at an optimal height for comfort and ease of control. The SPS3020EH can be set on edge just off to the side.

3.2 Deployment

Deploying the system can be as simple as placing it in the water. There are steps that can be taken in the planning and setup phase to ease operation and improve the potential for success.

1. **Knowledge of the area of operation**: A little research beforehand increases the knowledge of the operating area, improving the pilots' opportunities for success. Knowing the area and the potential risks allows the pilot to plan operations to avoid the risks. Attempting operations without a plan increases the risk of damage or loss.

2. **Plan the operation and follow the plan**: It is common for circumstances underwater to be significantly different than what was planned for. When this arises, it is a best practice to either surface the vLBV or stop operations until a new plan is devised. Attempting to charge forward without an updated plan will significantly increase the risk of damage or loss.

3. **Setting up the equipment**: It is best practice to set the equipment up facing the work area. If deploying off the starboard side of a vessel, orienting the monitor and hand controller so that the operator is facing to starboard eases the operator's sense of direction in relation to the deployment platform. While this is not a critical consideration, it should not be overlooked when setting up the system.

4. **Geographic reference**: The compass data output from the vLBV is a numeric value from 0-360 degrees. As humans we reference everything we do to our own orientation, as with item 3 above, the operator normally needs to know what direction he or she is facing in order to calculate the direction the vLBV is going. A simple method to help do this is to include a small magnetic compass as part of your setup. Doing this allows the pilot to look down at the compass and quickly determine the direction of vLBV travel at a glance.

3.3 Tether

Proper control of the tether is an important part of vehicle operations.

Do not deploy excess tether: Only use what is necessary to complete the job. Deploying too much tether places the vLBV and the tether at risk of damage. By only having the amount of tether in the water required for the free movement of the vLBV, the risk of entanglement is reduced and the risk of damage to the fiber line inside the tether is also reduced.

Active tether management is one of the key components to successful operation. A dedicated tether manager, that deploys tether as the operator drives away, and recovers tether as the operator returns is very useful. While this will not prevent entanglement, it significantly reduces the risk.

When operating in areas of high current, active tether management will also make the vLBV easier to operate. Reducing the amount of tether surface area exposed to the current reduces the effect of the current on the vLBV.

Another technique useful in high current areas is a system utilizing a clump weight attached to the tether to hold it straight up and down in the water column, with free tether below that to allow operation of the vLBV. Experience has shown that this should be limited to less than 30 meters of free tether below the clump weight. Delivered as part of your basic spares kit is a piece of hose designed to slip over the tether and provide an attaching point for the depressor weight. Along with this is the SeaBotix DOCS-038 Manual Clump Weight System Instructions. This information is also included on the CD of documentation delivered with your system.

3.4 Piloting

While anyone can operate a vLBV, piloting is a skill developed over time.

It is normal for each pilot to develop a particular skill set at which they excel. This should be taken into account when assigning tasks.

As discussed in the next segment, practice is the key to developing piloting skill.

3.5 Practice

As with many skills: practice, practice, practice.

When possible, practice in a pool or a confined body of water with few obstacles or entanglement hazards. This will give the operator experience on the controls, while reducing the added issues of dealing with current or poor visibility. As the operator gains familiarity with the controls and the response from the vLBV, training scenarios can be added to simulate the tasks required.

Objects can be added for training using the optional manipulator, optional sonars, and other sensors.

Once the operator is comfortable operating the system and the accessories, move to open water training. Slowly increase the complexity and task loading.

While time consuming, following this type of training regimen will pay dividends during operational use.

3.5.1 Watching the vLBV

During the initial phases of learning to operate the vLBV, it can be helpful to directly observe the vehicle while controlling it. This allows the operator to quickly get a feel for how the vLBV reacts to controls.

However, when the vLBV is pointed back in the operators' direction, the controls will react as they should, but the operators' perspective is reversed. What will happen is that the target will be to the right of the vLBV, but the operator will see it to the left, and turn in the incorrect direction.

When flying to a distant inspection point, most operators find it easier to fly to the location with the vLBV on the surface, and descend once the target is in sight. In this case direct observation of the vLBV can be beneficial.

3.5.2 Watching the Monitor

Learn to control the vLBV at all times while watching the video from the vehicle: Try not to look at the vLBV. This develops intuitive control of the vLBV.

If your target slides off the monitor to the left, the operator need only turn the top of the joystick to the left to re-acquire the target visually.

Once the vLBV is at depth, this is the only way to control the vehicle.

3.6 Controlling the vLBV

Proper hand placement when holding the OCU (Operator Control Unit) reduces operator fatigue and makes piloting easier. Proper hand placement is both hands on the controller, with the thumb and forefinger from each hand on the thruster controls. Take the joystick controls with your right hand, and use your left hand on the vertical thruster control knob as shown.

Use smooth movement of the joystick. A jerky motion with the joystick will result in the vLBV duplicating those actions underwater, making the video difficult to view and interpret.

When changing the direction of the vLBV, it is a best practice to turn while driving forward. If you stop, turn then move, during the period that the vLBV has no forward motion, water movement will then dictate where the vLBV is going, not the operator.

3.7 Thruster Gain Controls

There are two (2) settings for thruster gain controls incorporated into the vLBV: vertical and horizontal.

There are ten (10) steps from 10% to 100%, and the steps are referred to as Gains 1-0. Gain 1 is the lowest, and Gain 0 is the highest. These steps affect the maximum RPM that the thruster motors will operate at with a given joystick or vertical thruster control knob input. Thruster RPM equates to speed: higher thruster RPM=faster, lower=slower.

Lower gain settings allow the operator greater precision when positioning the vLBV for either video, or when attempting to recover an object using the optional manipulator.

Higher gain settings are useful when operating in current or piloting the vLBV to a search area located some distance from the deployment site.

Refer to Section 2.1.9 for specifics on changing the gain settings.

3.8 vLBV Trim Adjustments

Trimming the vLBV refers to the physical adjustment of the vLBV for neutral buoyancy. This is accomplished by adding floatation or weight to the vLBV to achieve neutral buoyancy, and a level trim, fore and aft, side to side. Three factors affect the trim: salinity, temperature and depth. Of these, the salinity has the greatest effect. A change in salinity of just 2 parts per thousand will change the trim by as much as 50 grams. Temperature will change the buoyancy by about 1 gram per degree and its effect is negligible. In the designed operating range for the vLBV, the effect of depth on buoyancy will primarily be an issue with the tether. As the tether compresses, it will decrease its displacement reducing the buoyancy.

Experience demonstrates that operation of the system is significantly enhanced when the system is properly trimmed.

When trimmed too light, or too heavy, the operator expends effort holding depth, rather than simply concentrating on the task.

As delivered from the factory, your system was trimmed per the sales order for either fresh water or salt water. At our facility, the water is about 19C when we set the trim. Your specific operating area may have colder or warmer water with a different salinity.

To adjust the trim, place the vLBV in a container of water of the salinity and temperature where it will be operated. Add or remove weights until the system sits just at the water surface and is level fore and aft, side to side. The bumper frames for the vLBV should just break the surface of the water. If optional top mounted sensors are included, the trim point moves up to the upper surface of the sensor.

3.9 Considerations When Using the Auto Functions

The auto functions incorporated into the controls for the vLBV were specifically designed to ease operation, and reduce operator overload during inspections.

3.9.1 Auto Depth

This function holds the vLBV at a specified depth. The operator drives the vLBV to the desired depth, and selects the AUTO DEPTH function.

The software will then take control of the vertical thrusters to hold the vLBV at the set depth.

Operation of the Vertical Thruster Control Knob will override the auto setting until it is returned to the neutral position.

An example of use of the AUTO DEPTH function; during a bottom survey, the operator is required to maintain a 2 meter HOB (Height over Bottom.) At the beginning of the flight, the operator flies the vLBV to the bottom, makes a depth reading, and then using the vertical thruster control knob, moves the vLBV 2 meters up from the bottom, then selects Auto Depth after the vLBV is stable at the new depth. The operator need now only concentrate on maintaining course and speed to provide the best video image, and the processor board and software will maintain the depth.

3.9.2 Auto Heading

This function holds the vLBV on a specified compass heading. The operator turns the vLBV to a desired course, and selects the AUTO HEAD function.

The software will then take control of the horizontal thrusters to hold the vLBV at the set heading.

Operation of the direction knob at the top of the joystick will override the Auto function. When the operator adjusts the course, the vLBV will lock to the new once the operator releases the controls.

An example for use of AUTO HEAD function; the deployment site is located at a distance from the survey site. The operator sets the vLBV on a heading required to get to the survey site. The operator selects Auto Heading, for course keeping, and then drives the vLBV forward to the location. Remember, water is rarely static, so course corrections are required to accommodate for set and drift caused by the currents acting upon the vLBV and the tether.

3.9.3 Auto Trim

The TRIM function refers to speed settings for all thrusters. When the TRIM function is engaged, the software locks all thrusters at their current speed setting. This is not to be confused with the GAIN settings. If the operator is thrusting forward at 50% throttle, the TRIM function will keep the thrusters running at that RPM once the operator releases the joystick. As with the other Auto functions, the operator can override the TRIM function by simply operating the appropriate control, joystick or vertical thruster control knob.

Section 4 Maintenance

The vLBV was designed to keep routine operator maintenance to a minimum.

The basic concept is that the operator will clean the exterior of the vLBV with fresh water after each operation. The operator will then dry the vehicle and stow it in preparation for its next deployment.

4.1 After Each Use

After retrieving the vLBV, it is the operator should immerse the system in a container of fresh water, run the thrusters for a period of about 2 minutes at low speed to rinse any salt, mud or other contaminants from the exterior of the system. Utilization of this method ensures the best clean possible.

If you are not able to do this, then use a hose with a low velocity spray nozzle to rinse the vLBV top and bottom. The vLBV can be stood on its rear to facilitate rinsing the underside.

When possible, allow the system to air dry prior to stowing in the provided transit case. Low pressure air and clean dry towels can be substituted to speed the drying process.

4.1.1 After Each Use (Dirty Water Conditions)

When the system is operated in dirty water environments with high sediment loads or significant biological activity or the presence of drifting debris, the cleaning process will need to be more involved.

First visually inspect the propeller guards for fouling. Any material sticking out from under the dome of a propeller requires the removal of both the propeller and the propeller guard, to remove the fouling. With material under the shroud of the propeller, the potential for the material to be ingested into the shaft seals of the propeller is increased.

To remove the propeller, remove the 2 ea 6mm radio pattern nuts, and pull the propeller off of the collet.

Remove any debris from underneath the propeller hub and re-install.

4.2 After Every 50 Hours

After every 50 hours of operational use, we recommend checking the fill level on the oil compensation bladders for each thruster.

This procedure should also be performed if the system has been stored for 6 months or more.

In the menu selection for the vehicle, there is a counter that records and will display hours run. Refer to Section 2.5.2.3 for instructions on how to access this information.

The materials required for this procedure are:

1. # 2 Phillips screwdriver (SeaBotix P/N TO015)
2. Oil Compensation Top Off Kit (OCT1500)

NOTICE

DO NOT substitute lubricant. Use of any lubricant other than that specified by SeaBotix may damage components and will affect the warranty.

Time required to perform this procedure is approximately 20 minutes.

A. Place the vLBV bottom side up on a flat stable surface.

B. Locate the oil compensation bladder on each thruster, visually verify that the bladder is filled and not flat or distended.

C. If required, add oil from the Oil Compensation Top Off Kit following the instructions in DOCS-011 provided with the kit
D. Connect and test system for proper operation.
Use Section 1.4 of this manual.

4.3 After 500 Hours

After 500 hours of use or 5 years, whichever comes first, we recommend replacing all of the seals on the vLBV.

4.4 Long Term

During the performance of the 50 hour and the 500 hour maintenance, the technician should visually inspect all metal exterior components and fasteners for signs of corrosion.

A faulty cable or component can allow a low voltage signal to short into the water causing corrosion to start.

The location and severity of corrosion may require replacement of the damaged part.

4.5 Repairs

All repairs should be carried out by SeaBotix trained technicians.

SeaBotix offers both in-house and field training courses to support the operator.

The maintenance manual offers step-by-step instructions describing disassembly, replacement and reassembly of the vehicle components. Anyone with moderate mechanical skill will be able complete the repairs when the instructions are followed exactly as written.

For further assistance please contact service@seabotix.com or call +1 619 450 4000 extension 124.

4.6 Software Upgrades

From time to time, SeaBotix may issue software upgrades to improve system performance, or to upgrade system capabilities.

For the latest revision of the operating software, please visit our website.
http://www.seabotix.com/service_support/software_update.htm

Section 5 The INC300 Series

The Integrated Navigation Console (INC) is an all in one solution for displaying and recording video operation, display of SONAR and tracking systems data and vLBV video in a single case with a single display panel.

The monitor is designed to increase its display brightness to match ambient lighting. For the operator, this means that the display brightness will not degrade as a result of direct sunlight reflecting off of the monitor.

Integrated into the assembly is a small but powerful processor unit with a 230 gigabyte internal hard drive.

A Video Enhancement system can also be installed.

Video recording is accomplished by utilizing a USB video capture device that is part of the processor unit. Recording can be accomplished to the internal hard drive, an external hard drive, or any other USB memory device such as a large capacity thumb drive.

SONARS, the Tritech Micron, the Tritech Gemini, the Teledyne BlueView or any other compatible device can be operated data displayed, and recorded using the INC. The recorded data can be output to any USB memory device connected to one of the two installed USB ports integrated into the lower panel.

Tracking can be operated in conjunction with the SONAR. The INC is capable of displaying and recording all of the data simultaneously allowing playback for review at a later time.

All data connections for the vLBV, power, video in, SONAR connection, and tracking system dunking transducer connections are located on the rear of the lower panel assembly.

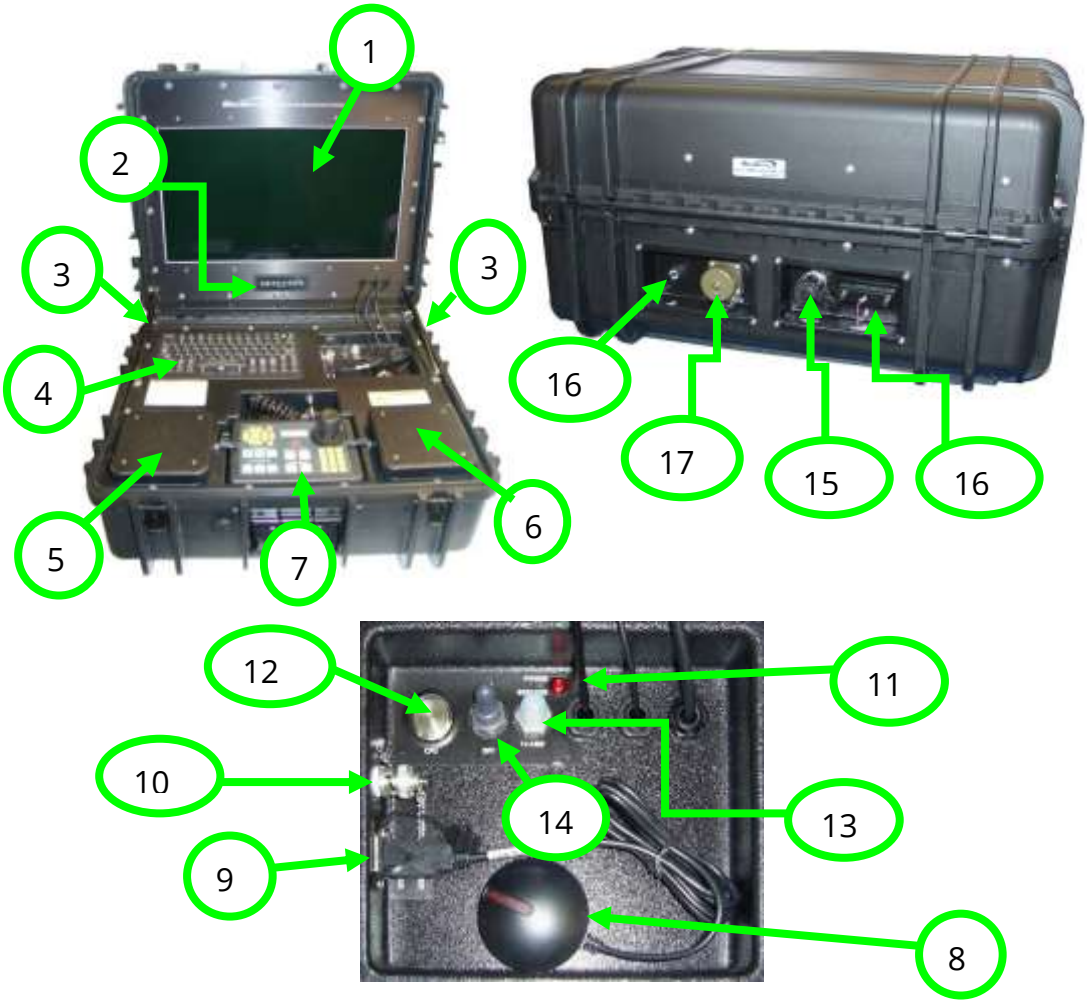
The case has a retractable handle and wheels to ease transport.

When closed the case is watertight and airtight. When opened the case conforms to IP52 rating.

Power for the INC300 is provided from the SPS3020EH

NOTE: The INC300 Series will not power up until the SPS3020EH is turned on.

5.1 Nomenclature INC:



1	Monitor	2	Monitor controls
3	Monitor lid strut	4	Keyboard
5	Exhaust fan	6	Intake fan
7	Operator control unit (OCU)	8	GPS receiver
9	USB port	10	Video output (AUX)
11	LED (Status/Power)	12	PC power button
13	Circuit breaker	14	Mains power switch
15	Ethernet connection	16	Dunking transducer connection
17	SPS-INC Interconnect (Power, Video and Data)	18	Fuse

Section 6 Power Requirements INC

The INC300 is powered by a 12VDC supply from the SPS3020EH

6.1 Powering up the INC

There are two (2) options at this point depending upon how the vLBV system is going to be used. Choose which option most suits your application for powering up the vLBV.

Full system operation utilizing sonar, tracking and/or video recording. This is the most common operating setup.

Video only. This is when a quick visual inspection is all that is required and no requirement for SONAR, tracking or video recording.

6.2 Full System Power Up

Step 1

With the SPS3020EH powered on, flip the grey power switch to the ON position.

Step 2

Press the CPU start button to begin the startup process for the processor unit.

NOTE: It may take a few minutes for the CPU to boot completely. Wait for the process to complete prior to opening any installed software.

Step 3

Once the processor unit has finished booting, press the red power button on the OCU (operator control unit).

NOTE: The red LED above the POWER button will illuminate and the amber STATUS LED on the SPS3020EH will begin to strobe 2 seconds on/off.

Step 4
Start the SONAR and Tracking software found in Quick Launch at the bottom left part of the processor unit screen.

Step 5

Adjust the windows on the display to suit operator preference.

6.3 Video Only Power Up

Step 1

With the power source on (generator running or circuit breaker on) flip the grey power switch to the ON position.

Step 2

Press POWER button on the operator control unit (OCU).

NOTE: The red LED above the POWER button will illuminate and the amber LED on the INC will begin to strobe 2 seconds on/off.

Video will display on the monitor within a few seconds. The overlay will display at the bottom of the display.

Section 7 vLBV Controls

The vLBV has been designed to be simple and intuitive to operate. A new operator should find that, after reading this manual and an hour or so of hands-on use, operating the LBV/vLBV is quite easy. Using the tips in this manual will help you to become a proficient and confident LBV/vLBV operator.

7.1 Operator Control Unit (OCU)

Operation of the vLBV is done via the operator control unit.

Refer to Section 2.1 of this manual for detailed instructions for use of the OCU

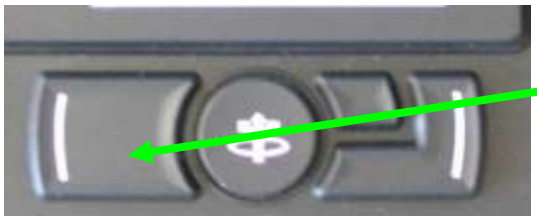
7.2 Processor Unit Control.

NOTICE Do not close the INC with the monitor or the processor unit powered up. This will cause the INC to overheat and may damage the components.

Power for the processor unit is controlled from the lower panel of the INC.

All other controls for the processor unit are accomplished utilizing the environmentally sealed keypad.

Mouse controls are via this section of the keypad.



1. Left mouse button.

2. Mouse operation.

7.3 Updating or Installing New Software

If additional software is required, and it was supplied on a CD/DVD disk, a separate CD/DVD drive will be required to be connected via one of the USB ports in the lower tray.

To update drivers, software, or the operating system, connect the INC to an Ethernet port connection via the Ethernet port on the rear of the INC. Once this connection is made, the update, download or other functions will be the same as on any other processor unit running Windows 7 Pro.

7.4 Backing up the hard drive

It is recommended that the user frequently make a backup copy of the hard drive and store it in a safe location. In the event of a system failure, all of the installed software can be quickly re-installed, reducing down time.
Should an operator, inadvertently make changes to configuration files, delete critical files, or re-configure ports, a recent back up copy of system files will allow quick recovery.

7.5 Recording Video

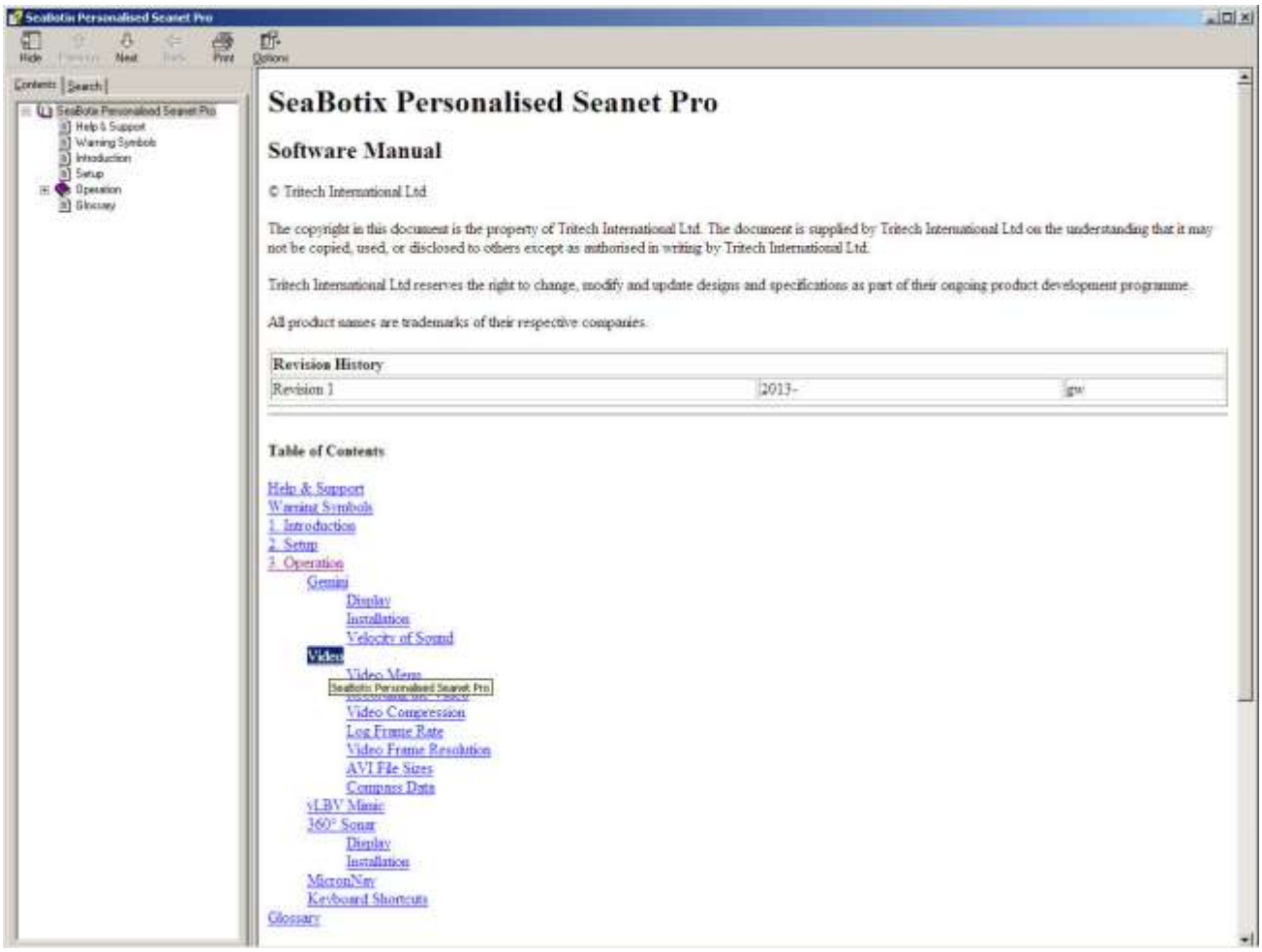
Installed in the INC is a video recording system that will allow the recording of composite video from the vLBV directly to the internal hard drive and external hard drive, or a large capacity memory device attached to the USB 2.0 ports in the lower panel.

7.5.1 Using the Video Recording Software

7.5.1.1 Open the Seanet Pro software manual on the INC300

7.5.1.2 Select the help menu, then select Seanet Pro (SeaBotix)

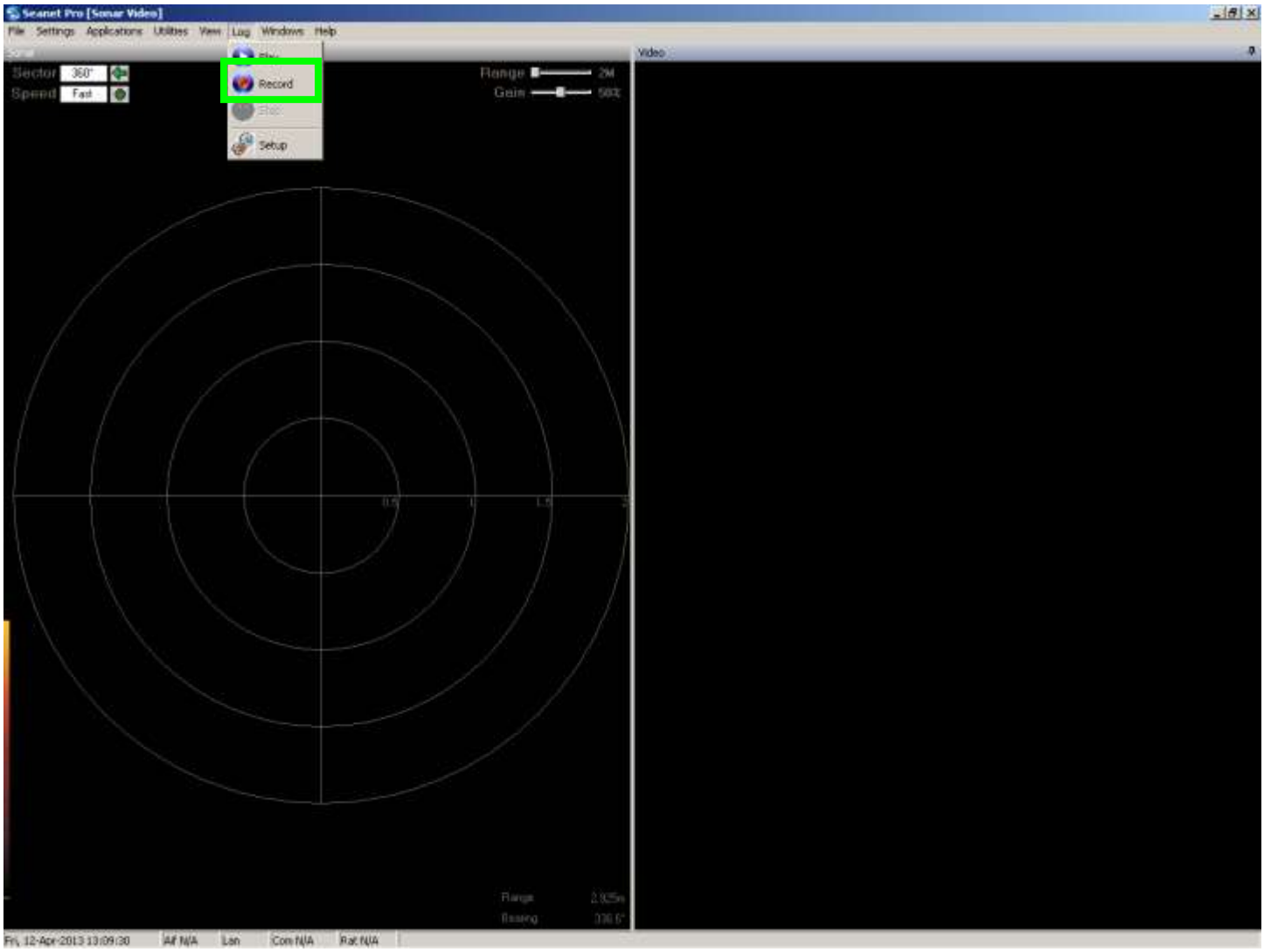
7.5.1.3 Go to the section on setting up the video recording section



7.1.5.4 Follow the instructions as written

7.1.6 Initiating Logging

Scroll the mouse over the **Log** pull down menu at the top of the Seanet Pro screen, and press the **Record** button



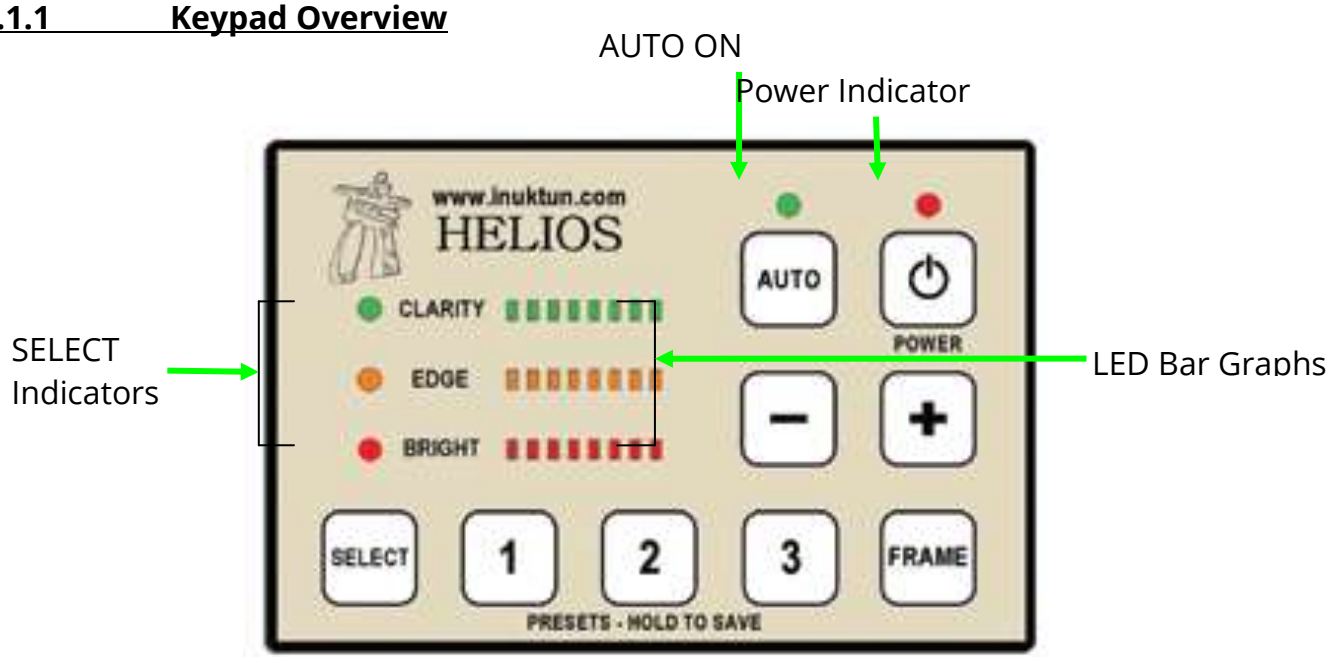
7.6 Monitor Settings

The monitor sleep settings are disabled. This is done to prevent the operator from closing the lid of the INC while the monitor is powered up and causing damage to the monitor. **Do not change this setting**.

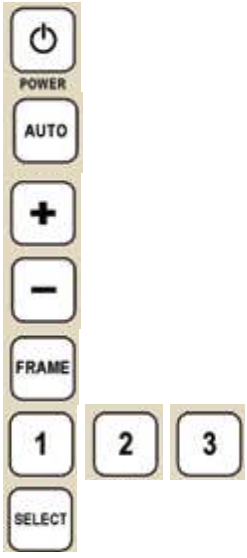
Section 8 Helios™ Real Time Video Enhancement System

8.1 Operation

8.1.1 Keypad Overview



8.1.2 Button functions:



Power On/Off: the power indicator will light when on

Clarity Auto: the Auto On Indicator will light when on

Setting Increase: the selected setting will increase once

Setting Decrease: the selected setting will decrease once

Helios™ Enhanced Frame Size/Location

Recall/Save Settings

Setting Select: use to select which setting to adjust

8.1.2.1 POWER On/Off

Press the power button to turn the Helios™ on or off. When the Helios first turns on, you will hear a small click and all LED's will illuminate for a short time. The power indicator will remain on while the Helios™ is on. The settings stored in be recalled.
If at any time the Helios™ appears to have frozen, turning the Helios™ off then on again will reset it.

8.1.2.2 Frame Adjustment

Press to change the Helios™ enhanced frame size. Each selection will cycle the FRAME from Center Enhanced, Half Enhanced and Full Enhanced. This is the portion of the image that is enhanced using your current settings. The rest of the image is in its original state.

8.1.2.3 Setting Adjustment

The adjustable settings available in Normal Mode are CLARITY, EDGE and BRIGHTNESS. Press until the desir setting is illumin d, ss or to increase or decrease the selected setting.

8.1.2.4 AUTO ON/OFF

Press to turn the CLARITY AUTO adjust on or off. When Auto is on, the AUTO ON indicator will illuminate and the CLARITY LED bar graph will turn off. When this feature is turned on, CLARITY will automatically adjust with the image to give the optimal setting. When this feature is off, the CLARITY LED bar graph will turn on and your current settings will be displayed.

8.1.2.5 SAVE/RECALL SETTINGS

To save your current settings there are three save slots available. Press and h 1 , 2 or 3 for about four seconds to save your settings. The LED bar graphs will blink in sequence to indicate the settings were saved.

To recall your settings, press 1 2 or 3 once. The settings will load and appear in the LED bar graphs.

8.1.2.6 RESTORE FACTORY DEFAULTS

To restore the factory default settings, press and h 2 3 ar + for about six seconds. The LED bar graphs will blink in sequence to indicate the settings were restored to the default values.

NOTE: Restoring factory defaults will permanently clear any previously saved settings.

Section 9 Maintenance for the INC

9.1 Filter Cleaning

This maintenance procedure should be completed after every 100 hours of operation or three months of use, whichever comes first.

Remove and clean the INC intake and exhaust air filters.

The filters can be cleaned using a vacuum cleaner, or washed with water then air dried.

If the filters still appear dirty after cleaning, replace them with SeaBotix Part Number SS661.

Removing the filters

1 Remove the four Phillips screws from each of the two covers

2 Remove both covers

3 Lift out the filters

4 Reverse to re-install

9.2 Cleaning the Monitor

Use any commercially available monitor cleaning wipes to remove water spots, finger prints, or lint from the monitor screen.

9.3 Cleaning the INC Case

Clean the exterior of the INC case with mild soap and water.

9.4 Inspection

Periodically inspect all of the connections on the INC for signs of corrosion or damage.

Section 10: Introduction to the SPS3020EH

The SPS3020EH is manufactured to provide up to 1700 watts of power to the vLBV at a nominal 360 volts DC.

The SPS3020EH automatically detects the input voltage and is compatible for operation on 110VAC/220VAC 50/60Hz. When operating on 110VAC, the system requires two separate 20 Amp supplies.

10.1 Unpacking the SPS3020EH

The system is housed in a weather resistant case. The case is equipped with wheels and a retractable handle to facilitate transport.

There are no user serviceable parts inside.

It is recommended that the user not open the enclosure except under specific direction from the factory.

10.2 Nomenclature

A. Main Power Switch

B. Main Power Input Connector

C. Tether Connector

D. INC Interconnect Cable CBA210

10.3 Power Requirements

The SPS3020EH requires either:

A. Two separate 20 Amp supply circuits with an earth ground when powered with 110VAC.

B. A single 20 Amp 220VAC supply with earth ground.

When powering the system there must be an earth ground reference. When using a portable generator, this can be achieved by connecting a wire to the ground connection on the generator and placing the other end in the water where the vLBV will be operated.

Do not use a GFI outlet for the power source.

Do not use a signal conditioning power strip for power to the system.

Do not use a UPS (Un-interruptible Power Supply) to power the system.

10.4 Connecting the system

All connections for the vLBV system should be connected from the vLBV to power.

Refer to Section 1.4.3 of this manual for connection instructions

When powering the vLBV300 System there must be an earth ground reference.
When using a portable generator, this can be achieved by connecting a wire to the ground connection on the generator and placing the other end in the water where the vLBV will be operated.

10.5 Operating environment

The SPS3020EH is air cooled. The operator must ensure that there is sufficient air flow around the system to prevent damage due to overheating.

The equipment should be set up in a well ventilated area. When set up for operation, the SPS3020EH is weather resistant.

The operational temperature range for the SPS3020EH is 0°C to 50°C (32°F to 122°F).

Section 11 SPS3020EH Controls

Power Indicator

Status Indicator

Main Power Switch

Section 12 SPS3020EH Operations

12.1 Operating the SPS3020EH

Once powered on the operation of the SPS3020EH is automated. The power supplies will adjust output automatically to supply the load demand from the vLBV.

There are no operator controls to adjust, just connect it to the system and turn it on.

Do not energize the SPS3020EH until all equipment connections are made.

12.2 Powering Up the SPS3020EH

A. Turn on the SPS3020EH.

The power indicator will illuminate and the operator will hear the cooling fans start.

B. Wait for the Status light to illuminate.

This will happen approximately two seconds after the power light illuminates

C. Once the STATUS light is lit, the SPS3020EH is now ready for use.
The operator now presses the POWER button on the Operator Control Unit to enable power output to the vLBV.

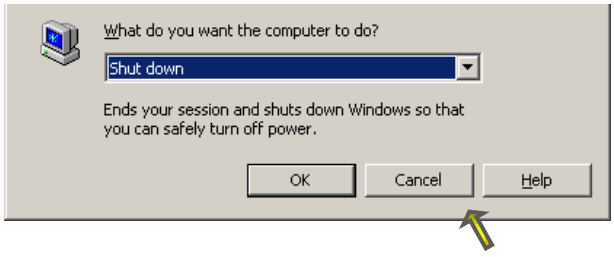
D. The STATUS light will now cycle on/off at a 2hz rate On for two seconds and off for two seconds

E. Press the processor (CPU) start button on the INC.

12.3 Powering off the SPS3020EH

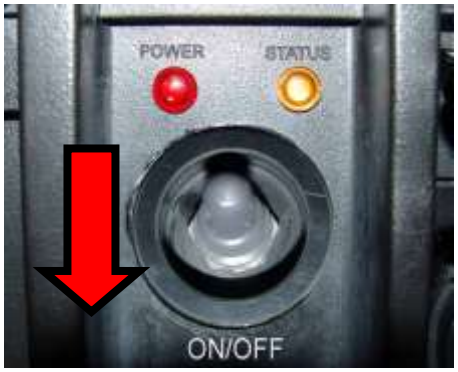
To power off the SPS3020EH there is a specific process to follow.

A. Press the power button on the Operator Control Unit of the INC.


What do you want the computer to do?
Shut down
Ends your session and shuts down Windows so that you can safely turn off power.
OK
Cancel
Help

B. Shut down the processor using the Windows™ shut down menu

C. After the processor shut down is complete turn off the power breaker for the INC300 Series



D. Now turn off the SPS3020EH.

E. After the fans in the SPS3020EH have stopped running, the operator can disconnect power and data cables and pack the system for transport

Section 13 Fault Isolation the vLBV

Fault isolation for the vLBV requires knowledge of system power, interconnect, and operation.

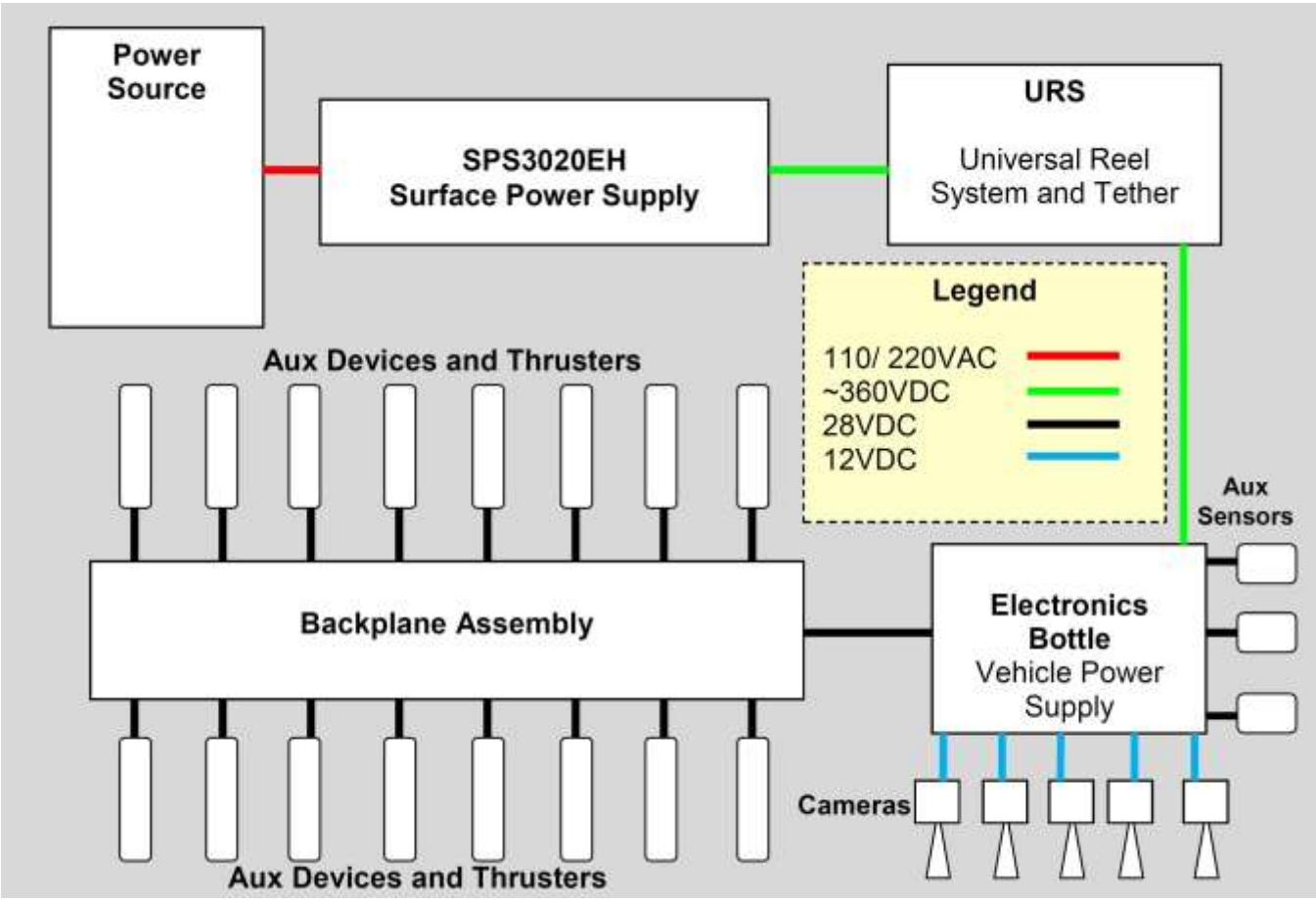
The basic system components can be broken down into three portions. They are listed in priority:

1. Power
2. Control
3. Video

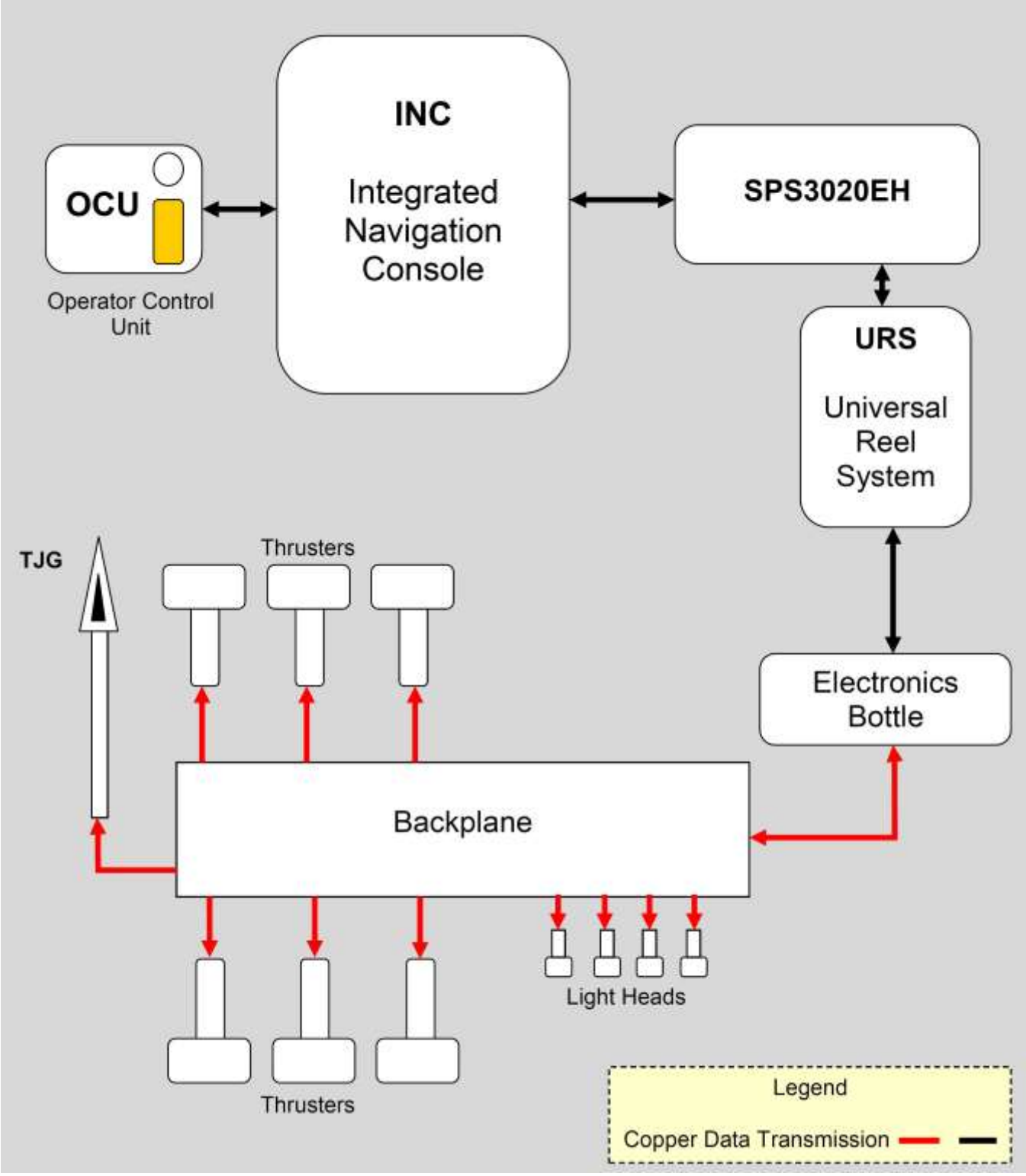
The technician/operator must first determine where the base fault is, and resolve issues in sequence:

Resolve power issues before addressing control issues. Resolve control issues before addressing video issues

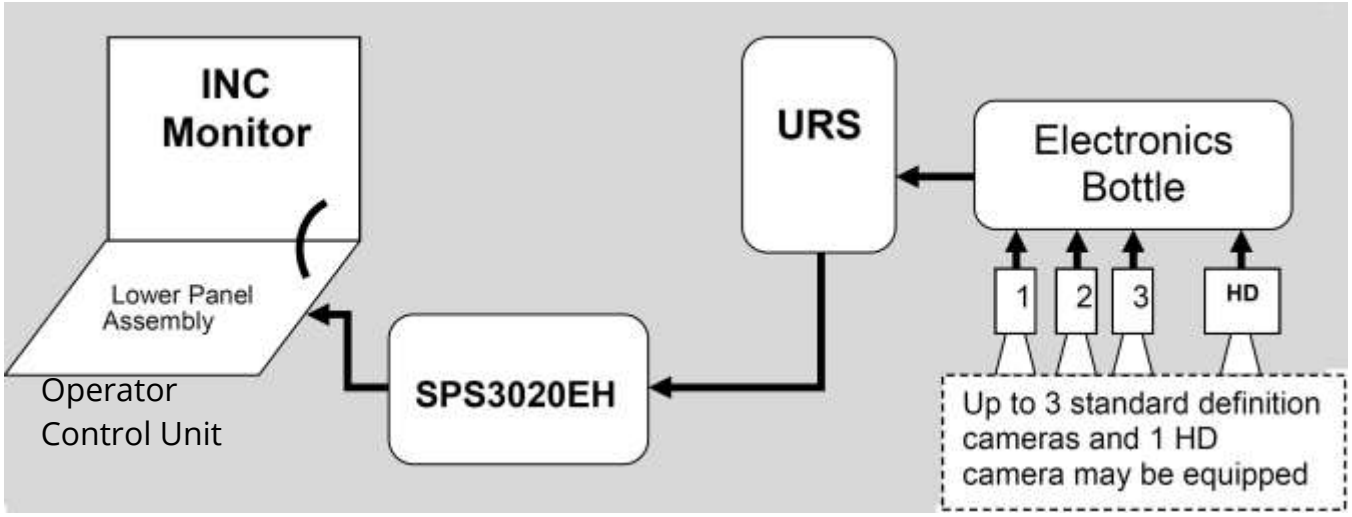
13.1. Basic Power Block Diagram



13.2 Basic (Control) Communications Block Diagram



13.3 Basic Block Diagram Video



Video is routed into the lower panel of the ICC/INC through a video distribution board, where it is routed to a video out connection and to the monitor.

13.4 Theory of Operation

Control of the vLBV starts and ends at the Operator Control Unit (OCU). The operator generates a command via the joystick, vertical thruster control knob, or keypad. The data is transmitted to the Sensor Nav Board and is converted from RS-232 to Ethernet for transmission to the vLBV via the tether.

The data transmission to and from the vLBV is over a 100MB Ethernet vDSL line of a twisted pair of wires embedded into the tether

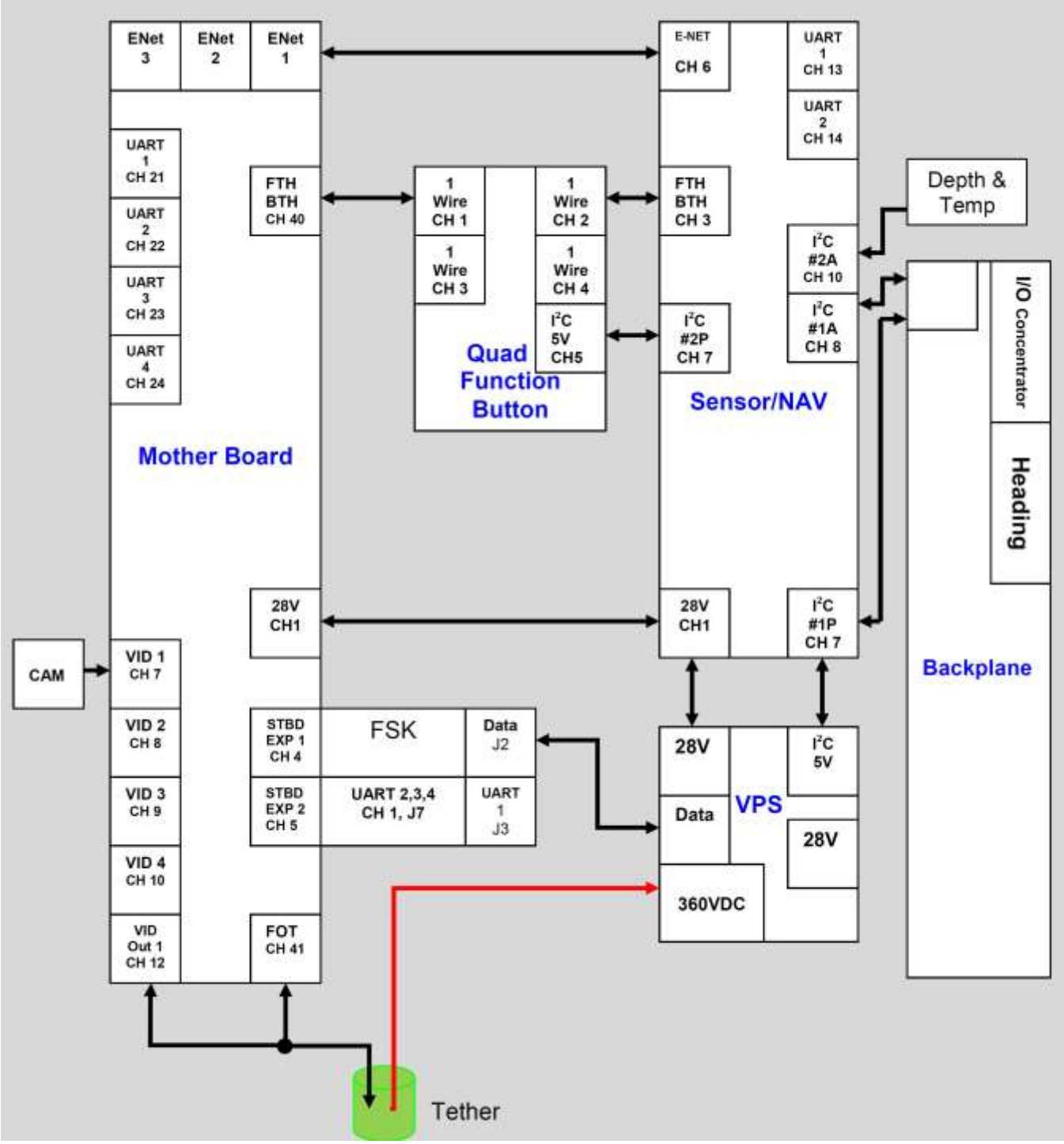
Once the data transmission is received at the Electronics Bottle Assembly on the bottom side of the vLBV, the Ethernet data is converted back to RS232 data. It then is transmitted to the Central Processor Board for routing to the specified device.

The Mother Board sends a response back to the OCU to acknowledge the command. This allows the system to verify that commands are received.

The Mother Board passes the operational command to the I/O Concentrator for routing to devices connected to the Backplane such as lights, thrusters, or auxiliary devices like the Three Jaw Grabber.

Thrusters, lights and auxiliary devices are controlled using I^2C buss. On power up, the system polls each of these devices to populate a table allowing the Central Processor to communicate and control them.

13.5 Functional Block Diagram vLBV



Section 14 Fault Isolation for the INC

14.1 INC Fails to Power Up.

14.1.1 Verify that the vLBV is properly connected to a power source, a generator, or other AC supply.

14.1.2 Verify that the proper voltage is present. If the supply voltage is below 100 VAC, locate a suitable source of power. When checking the AC voltage, measure between the 2 (two) blade sockets. Also, be sure to measure from each blade socket to the ground socket. Voltage from the blade to ground may measure ½ of the total voltage.

14.1.3 If the proper voltage is present, and the red power LED fails to illuminate, contact service@seabotix.com or call +1-619-450-4000 x 124 for assistance.

14.2 The vLBV Does Not Power Up

14.2.1 Power off the INC and verify that all connections are properly mated.

14.2.2 Power up the INC and SPS3020EH ONLY! (Do not energize the processor unit.)

14.2.3 Verify that the red LED and the amber LED are illuminated on the SPS3020EH prior to attempting to power on the vLBV. (Refer to Section 6.1)

14.2.4 Verify the camera tilts to plus 90 degrees.

14.2.4.1 If the camera does not tilt, turn the system off, disconnect the tether from the vLBv and check for voltage on the female connector. Place the positive lead from a multi-meter set to read >400VDC into the socket for pin 3, and the black lead into the socket for pin 2. The multi-meter should read about ~360VDC. *Refer to section 15.1 for detailed instructions.*

14.2.4.2 No voltage present. Fuse F1 on the surface power supply board may be open. Remove all power from the vLBV and check the status of the fuse using a multi meter on the resistance scale. Pass is zero ohms. If any reading is other than zero ohms, replace F1, close the lower panel and retest.

14.2.5 If the performance of these steps fails to resolve the issue, contact service@seabotix.com or call +1-619-450-4000 x 124 for assistance.

4.3 No Video from vLBV Displayed

14.3.1 Power on the Processor unit

14.3.2 Open the Seanet Pro software and check to see if video is displayed in the video pane of the software.

14.3.3 If video is displayed in Seanet Pro, the issue is with the video multiplexer unit inside the INC.

14.3.4 If there is no video displayed contact service@seabotix.com or call +1-619-450-4000 x 124 for assistance.

14.4 Processor Unit Does Not Boot, No Processor Video

Note: The processor unit does not self boot on power up of the vLBV. The operator must select the processor power switch on the INC to start the processor.

14.4.1 Processor unit fails to boot: Press and hold the processor power switch for 5 seconds to force a shut down.

14.4.2 Wait 10 seconds and press the processor power switch.

14.4.3 Verify that the following indicators light up on the keyboard; Caps Lock, Num Lock & ScrLk. After approximately 5 seconds, Caps Lock and ScrLk will go out, and only Num Lock will remain lit, indicating that the boot process is operating correctly.

14.4.4 Press the PIP/Exit switch on the monitor control panel and verify that the monitor is not in an vLBV only display mode.

14.4.5 If the processor fails to initialize, press the menu button on the monitor and check the status of the VGA signal line. If it reads “No Signal”, then the video driver for the processor unit is not outputting a signal.

14.4.6 If the above steps do not resolve the issue, contact service@seabotix.com or call +1-619-450-4000 x 124 for assistance.

14.5 HELIOS™ Not Processing the Video Signal

14.5.1 Verify the following after pressing the power button on the HELIOS™ control pad.

14.5.1.1 The blue power light behind the logo illuminates.

14.5.1.2 The vLBV video displays a color bar test pattern for approximately 2 seconds, then returns to the vLBV video feed.

14.5.1.3 Verify by pressing the + and the – keys that the video enhancement increases and decreases.

14.5.1.4 Press the size button and verify that the size of the enhanced section of video changes size.

14.5.2 If power up fails, then contact service@seabotix.com or call +1-619-450-4000 x 124 for assistance.

14.6 SONAR Fails to Initialize

14.6.1 Upon boot up of the processor unit, and after power up of the vLBV system, open the "SeaNet Pro" software.

14.6.2 After approximately 15 seconds, the SONAR should start to sweep and the video should display on initialization in the video box.

14.6.2.1 If the sweep fails to initialize after 15 seconds, check the status of the SONAR head on the vLBV. The power on LED on the front of the unit should be lit, indicating that it is getting power from the vLBV.

14.6.2.2 Close the SeaNet Pro software and open up the SeaNet Setup Software. Status for the 1st channel should indicate OK on a green field.

14.6.2.3 Select the Utilities, Com Setup. The 1st line (AIF) should list a device on a green field in the status column.

14.6.2.4 If all of this checks out properly, close the setup software and re-initialize SeaNet Pro. Allow the software to sit for 2 minutes to give it time to establish a link with the SONAR head.

14.6.3 Verify that the com channel is properly set up. Refer to the Tritech User's Manual included in the Software CD on the SeaNet Pro software CD.

14.6.3.1 AIF (The SONAR head) should be set to COM1.

14.6.3.2 Baud rate 115200.

14.6.3.3 The enabled box should be checked.

14.6.3.4 The status field should be green with the device listed.

ATTENTION! Do not change the channel assignments for the SeaNet software as this is critical for proper operation. The connected devices are hardwired to those ports!

14.6.4 If the settings are correct in step 6.6.3, and steps 6.6.2.1 is correct, contact service@seabotix.com or call +1-619-450-4000 x 124 for assistance.

14.7 Loss of vLBV Communications

14.7.1 Loss of vehicle communications is signaled by the system flashing the Auto Heading and Auto Depth LED's on the OCU or the video displaying "Acquiring OCU Comms" and or "Acquiring NAV Comms". If these conditions are present there may be no SONAR operation as well.

14.7.2 Power off the entire vLBV; shut down the processor unit first using the Windows™ shutdown selection before turning off the vLBV.

14.7.3 Power the vLBV back up in the video only mode following procedure 2.1.1.2. Note the following indications or lack thereof on the monitor.

14.7.3.1 Video is displayed

14.7.3.2 The following graphic is displayed on the vLBV video, "SeaBotix vLBV300" on 2 lines at the top center of the video for about 1 second.

14.7.3.3 Only the vLBV video is displayed for about 1-2 seconds.

14.7.3.4 Overlay data is presented at the bottom of the screen. Refer to Section 2.2

14.8 Additional Trouble Isolation Tips

With all vLBV's having similar electronics, swapping vLBV components from one vLBV to the other will assist you in identifying the faulty component.

NOTE: Verify that the donor system and the tested system have the same software revision levels

It is recommended that the fully operational vLBV be utilized to isolate the faulty component from the non-functioning vLBV.

Move the components one device at a time into a known good vLBV.

Once a device or component is identified as faulty, replace it with a known good component and continue testing.

Performing fault isolation in this method will assist the technician in the unlikely event that there are multiple issues.

Do not hesitate to contact service@seabotix.com or call +1-619-450-4000 x 124 for assistance.

Section 15: Fault Isolation SPS3020EH

If the operator suspects an issue with system power, follow the steps below to isolate the fault.

1. Check the voltage output displays for both the master and slave power supplies. Both outputs should read approximately the same voltage level.

2. Check the current output levels on both master and slave power supplies. These outputs should also read approximately the same level.

If all SPS3020EH indicators are as expected, the operator needs to unplug the vLBV from the tether, using a DC voltmeter, measure the voltage at the vLBV end of the tether.

15.1 Checking Voltage Supply at the vLBV End of the Tether

Face View

A. Set the DC voltmeter to a 800VDC or higher scale.

B. Place the tip of the red meter lead in the socket marked 3.

C. Place the tip of the black meter lead in socket 1. Turn the system on and read voltage. The voltage reading should correspond to the voltage output display on both master and slave power supplies.

D. Turn the system off using the **POWER** button on the OCU.

E. Move the black meter lead to socket 2, turn the system on, and read the voltage.

If no voltage is detected on the vLBV end of the tether, continue to step 15.2 to isolate the URS from the SPS3020EH.

If voltage is correct at this point, the power issue is localized to the vLBV.

15.2 Checking the Voltage Output at the SPS3020EH

Face View

A. Unplug the tether whip connector from the SPS3020EH.

B. Use a DC voltmeter set for 800VDC or higher scale

C. Place the red DC voltmeter lead in socket 3 of the umbilical whip connection

D. Place the black DC voltmeter lead in socket 2 of the umbilical connection

E. Energize the system, measure the voltage output, then turn the system off.

F. Move the black DC voltmeter lead to socket 1 of the umbilical connection, turn the system on and measure the voltage.

15.2.1 If no voltage out is detected at this point, the issue is with the SPS3020EH surface power supply board.

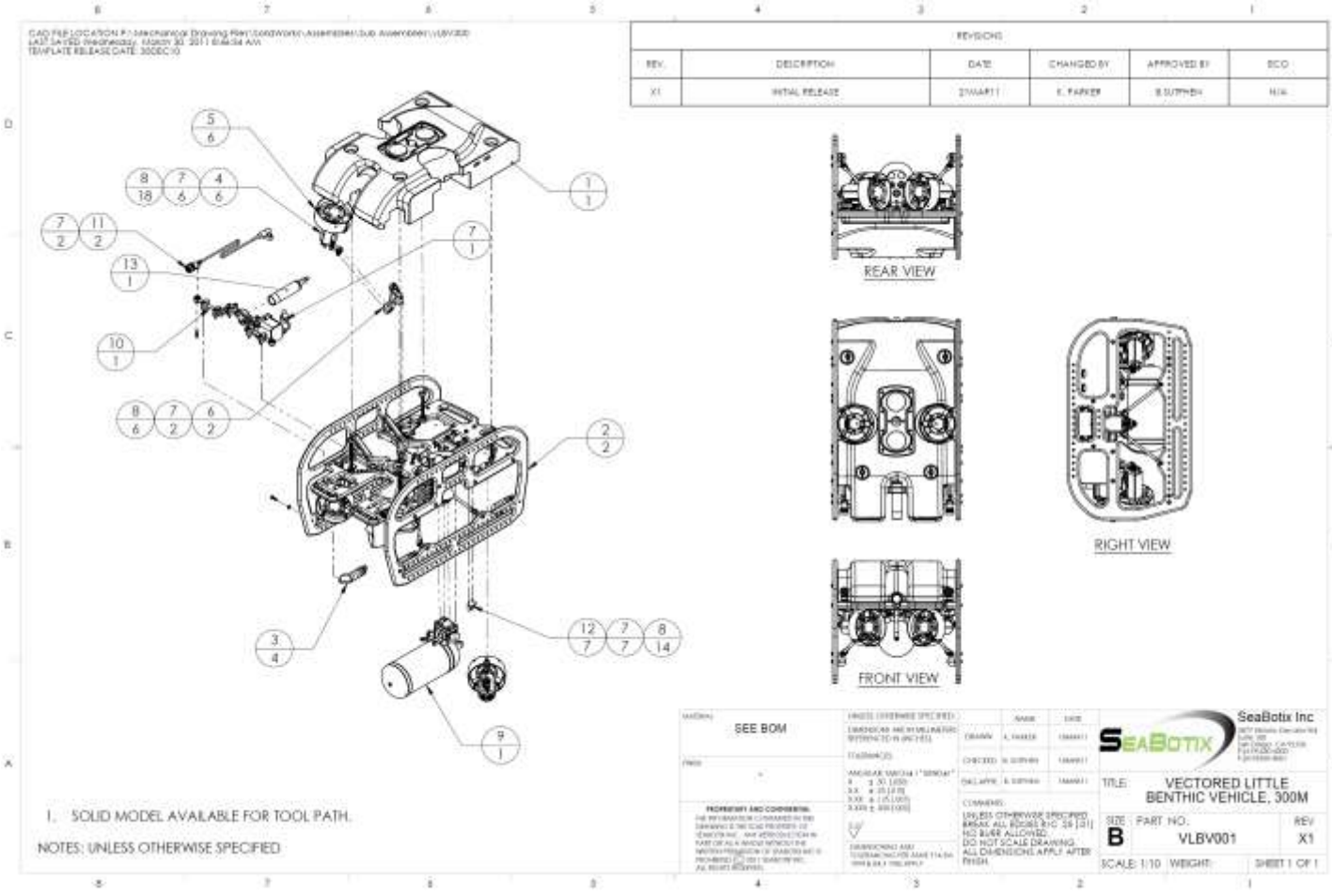
Check the condition of the fuse at F1 on the surface power supply board located inside the SPS3020EH.

15.2.2 When the operator energizes the system using the POWER button on the operator control unit of the INC an audible click should be heard indicating that the relay has energized sending power to the output. If this is not happening, contact SeaBotix service department via phone +1 619 450 4000 x 124 or via e-mail service@seabotix.com.

If correct voltage is detected, the issue is with the Universal Reel System or the tether. Please contact SeaBotix service department via phone +1 619 450 4000 x 124 or via e-mail service@seabotix.com if this is the case.

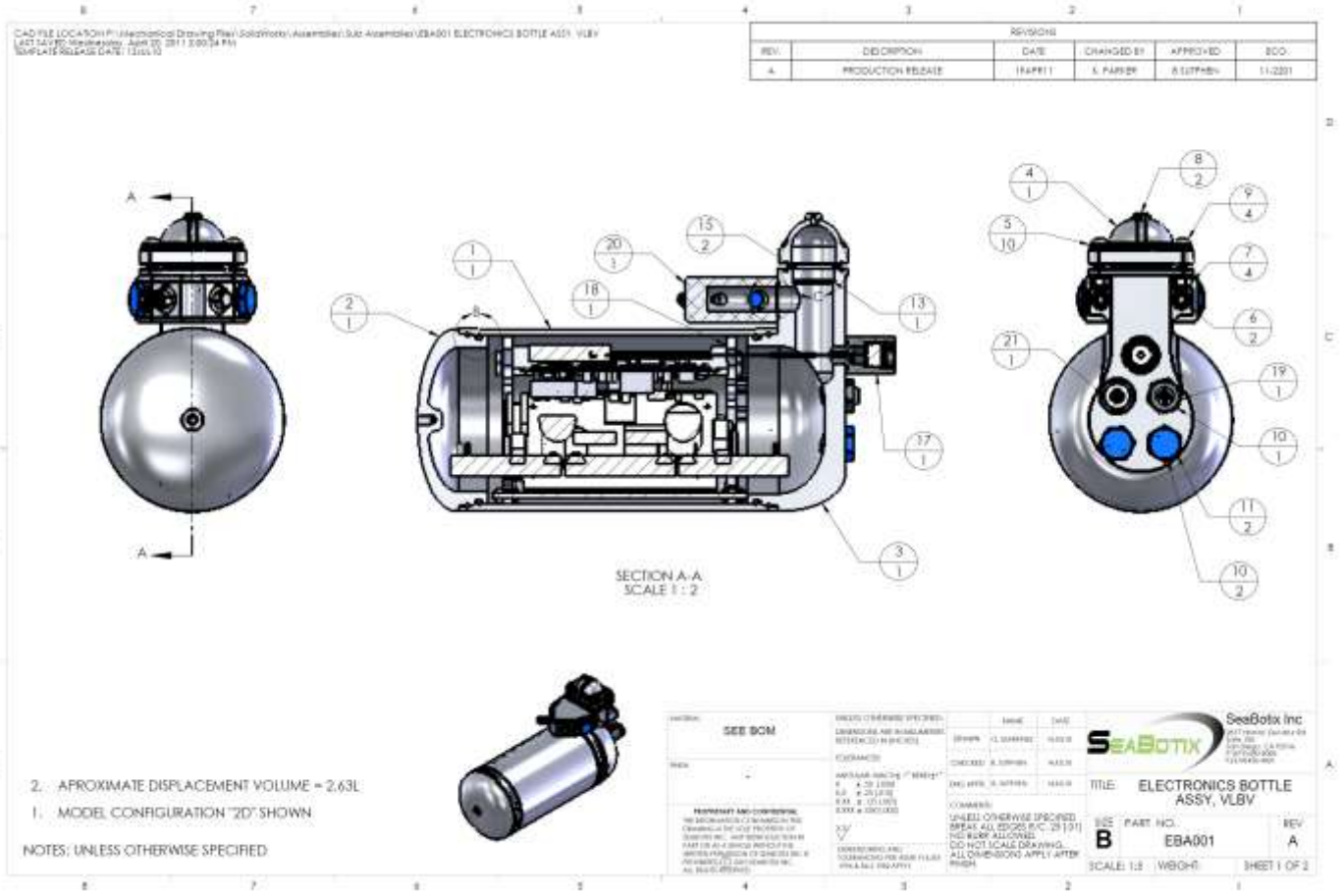
Section 16 Exploded Diagrams and Parts Lists

16.1 vLBV



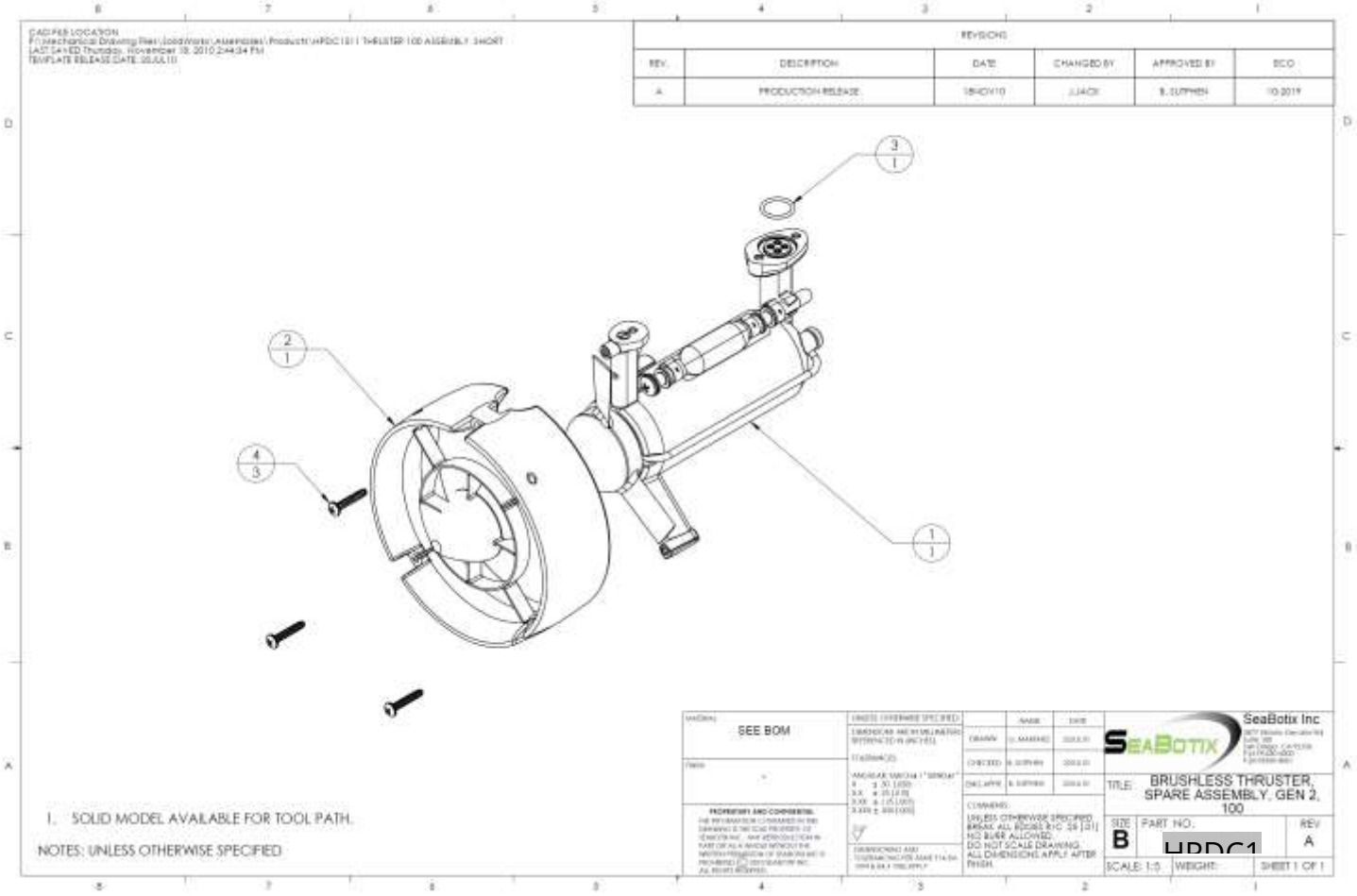
Lvl	Typ	Seq	Part Number	Revision	Alt	Description	Qty/Parent	Required Qty	UM
			VLBV001	A		Vectored Little Benthic Vehicl		1.00000	EA
1	Asm	1	.FLA001	C		Float Assy, 300M, vLBV	1.00000000	1.00000	EA
1	Asm	2	.FRA002	A		Frame Assembly, 390, vLBV	2.00000000	2.00000	EA
1	Asm	3	.BTA001	A		Ballast Assembly, Tungsten	4.00000000	4.00000	EA
1	Asm	4	.BLA1510	B		Brushless Thruster 100 Assembl	6.00000000	6.00000	EA
1	Asm	5	.SKA001	A		Kort Nozzle Assy, 100	6.00000000	6.00000	EA
1	Mtl	6	.VEA1501	A		Assembly, Vertical Thruster El	2.00000000	2.00000	EA
1	Mtl	7	.SL304			O-Ring, 2-014, Buna-N, 70D, Co	18.00000000	18.00000	EA
1	Mtl	8	.FN903			Screw, Plastite, #6 x 1/2", 18	38.00000000	38.00000	EA
1	Asm	9	.EBA	A		Electronics Bottle Assembly, v	1.00000000	1.00000	EA
1	Asm	10	.TLM001	A		Tilt Mechanism, vLBV	1.00000000	1.00000	EA
1	Asm	11	.ELS1094	B		Assy, External Lighting System	2.00000000	2.00000	EA
1	Mtl	12	.MA945	A		Plug, Auxiliary Blank, Modifie	7.00000000	7.00000	EA
1	Asm	13	.VI340	A		Camera, Color with Hummer Conn	1.00000000	1.00000	EA
1	Mtl	100	.LB762	A		Label Set, Vehicle Float, vLBV	1.00000000	1.00000	EA
1	Mtl	110	.CBA764	A		vLBV Video Camera Cable Assemb	1.00000000	1.00000	EA
1	Asm	120	.PCT113-000	A		PCT, IO Concentrator, NT, 16x	1.00000000	1.00000	EA
1	Asm	130	.PCT118-000	A		PCT, Compass Interface # 1	1.00000000	1.00000	EA
1	Mtl	140	.EC1366			OS4000-T Nano Compass Board	1.00000000	1.00000	EA

16.1.1 Electronics Bottle



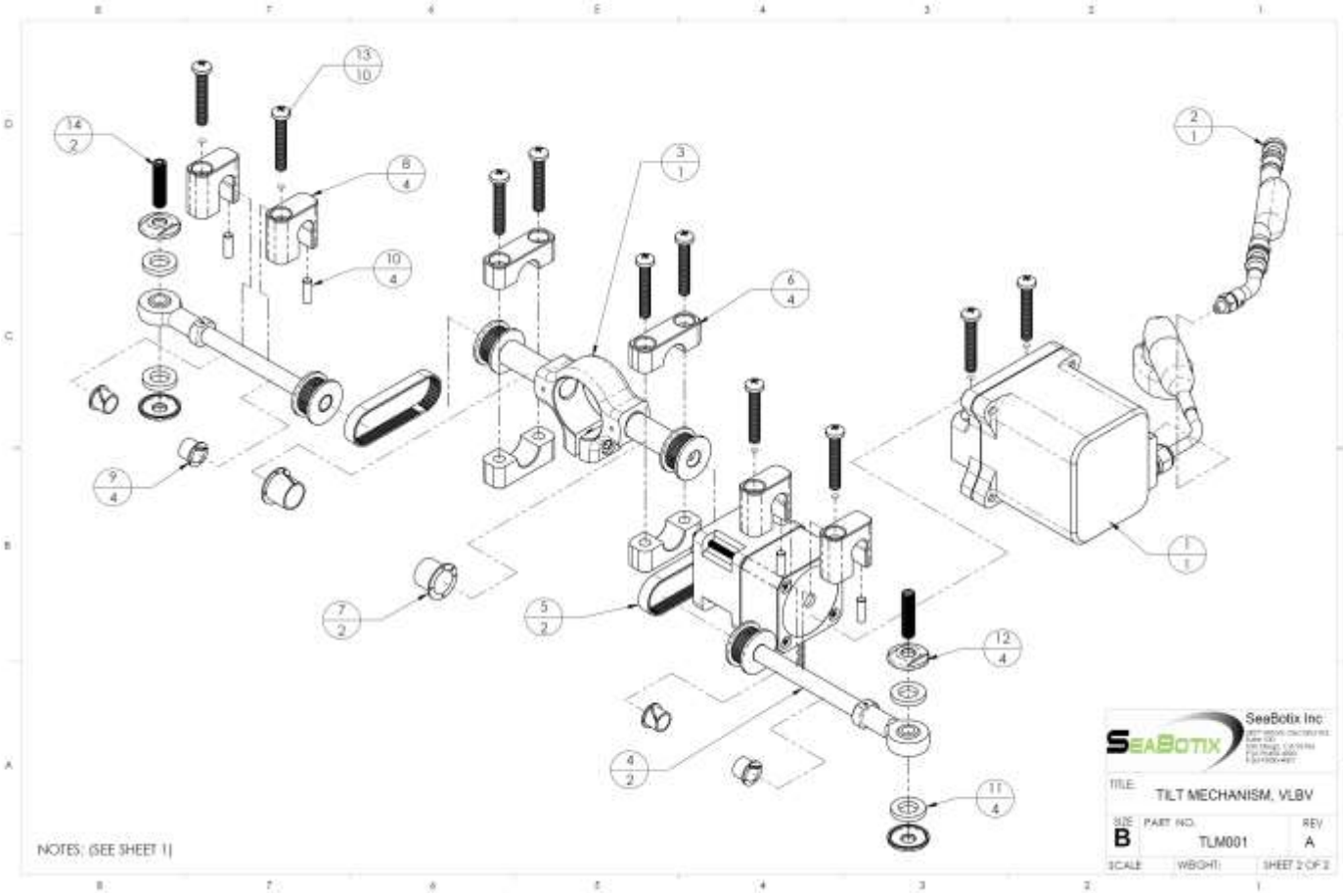
Lvl	Typ	Seq	Part Number	Revision	Alt	Description	Qty/Parent	Required Qty	UM
			EBA001	A		Electronics Bottle Assembly, v		1.00000	EA
1	Mtl	1	.MA1086	A		Tube, Electronics Bottle, vLBV	1.00000000	1.00000	EA
1	Mtl	2	.MA1084	A		End Cap, Closed, Electronics B	1.00000000	1.00000	EA
1	Mtl	3	.MA1085	C		End Cap, Open, Electronics Bot	1.00000000	1.00000	EA
1	Mtl	4	.MA1121	A		End Cap, Oblong, vLBV	1.00000000	1.00000	EA
1	Mtl	5	.FN833			Washer, M6, Flat, 316SS	10.00000000	10.00000	EA
1	Mtl	6	.FN860			Screw, M6-1.0 x 10, SHCS-SK, 3	2.00000000	2.00000	EA
1	Mtl	7	.FN323			Nut, M6, Nyloc	4.00000000	4.00000	EA
1	Mtl	8	.FN313			Screw, 10-32 x 3/8", Silicone	2.00000000	2.00000	EA
1	Mtl	9	.FN388			Screw, M6 x 25, Button Head	4.00000000	4.00000	EA
1	Mtl	10	.SL304			O-Ring, 2-014, Buna-N, 70D, Co	3.00000000	3.00000	EA
1	Mtl	11	.MA314	G		Plug, Camera Housing	2.00000000	2.00000	EA
1	Mtl	12	.FN559			Retaining Ring, Motor Housing	0.67000000	0.67000	MT
1	Mtl	13	.HW021			Retaining Ring, 25mm Bore	1.00000000	1.00000	EA
1	Mtl	14	.SL923			Seal, O-Ring, Buna-N, AS568A-2	2.00000000	2.00000	EA
1	Mtl	15	.SL107			O-Ring, 1-1/2"OD, 1-3/8"ID, Bu	2.00000000	2.00000	EA
1	Mtl	16	.SL921			Seal, O-ring, Buna-N, AS568A-0	1.00000000	1.00000	EA
1	Asm	17	.DTA1000	A		Depth & Temp Sensor Assy., 100	1.00000000	1.00000	EA
1	Asm	18	.ERA001	B		Electronics Rack Assembly	1.00000000	1.00000	EA
1	Mtl	19	.MA302	D		Housing, Vacuum Fitting	1.00000000	1.00000	EA
1	Asm	20	.MAN002	A		Manifold, Input-Output, 4 Port	1.00000000	1.00000	EA
1	Asm	21	.FIA1501	A		Fiber Interconnect, FO Assembl	1.00000000	1.00000	EA
1	Asm	30	.PCT117-000	A		PCT, Electronics Bottle Backpl	1.00000000	1.00000	EA
1	Mtl	40	.CN024			Connector, 3 Contact, Male, Bu	1.00000000	1.00000	EA
1	Mtl	50	.CN403			Locking Sleeve, Female	1.00000000	1.00000	EA

16.1.2 Thrusters

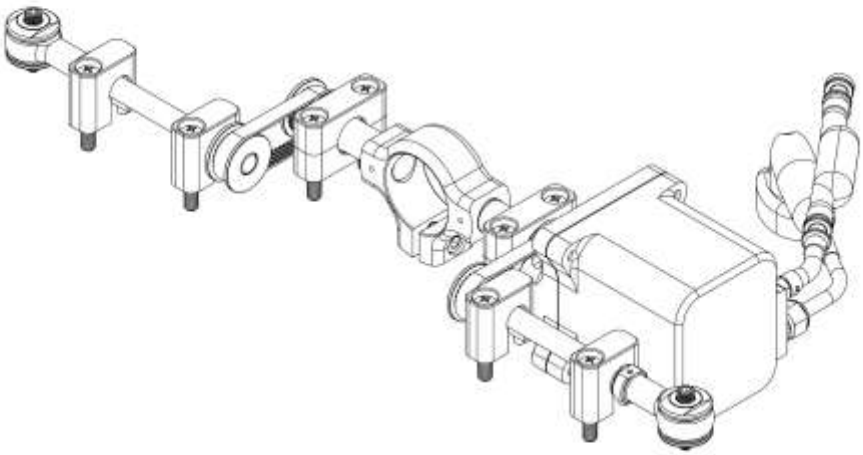


Lvl	Typ	Seq	Part Number	Revision	Alt	Description	Qty/Parent	Required Qty	UM
			BLA1510	B		Brushless Thruster 100 Assembl		1.00000	EA
1	Asm	1	.MO310	A		Motor, BLDC, Thruster, Electri	1.00000000	1.00000	EA
1	Mtl	2	.MA1072	A		Tube, Thruster, Short	1.00000000	1.00000	EA
1	Mtl	3	.SL329			Back-up Ring, Thruster Tube, 8	2.00000000	2.00000	EA
1	Mtl	4	.SL313			O-Ring, Thruster Tube, 2-029 B	2.00000000	2.00000	EA
1	Mtl	5	.MA561	D		Seal, Cartridge Retainer, Line	1.00000000	1.00000	EA
1	Mtl	6	.ML341	C		Seal, Double Cartridge	1.00000000	1.00000	EA
1	Mtl	7	.SL317			O-Ring, 2-106, Viton Quad Ring	2.00000000	2.00000	EA
1	Mtl	8	.SL315			O-Ring, Cartridge Retainer, 2-	1.00000000	1.00000	EA
1	Mtl	9	.FN044			Screw, #6 x 3/8", Phillips Fla	4.00000000	4.00000	EA
1	Mtl	10	.WF310	A		Bale, Thruster, Short	1.00000000	1.00000	EA
1	Mtl	11	.ML405	B		Propeller, 3 Blade, 100XL	1.00000000	1.00000	EA
1	Mtl	12	.FN902			Nut, M6 x1 x3.2, 316SS	2.00000000	2.00000	EA
1	Mtl	14	.MA1075	A		Collet, 4mm Bore, M6 Thread	1.00000000	1.00000	EA
1	Mtl	15	.MA1125	A		Pin, 5mm, Prop Collet	1.00000000	1.00000	EA
1	Asm	16	.OCA1503	A		Assembly, Oil Compensation Tub	1.00000000	1.00000	EA
1	Asm	18	.BLC1504	A		Brushless Thruster 100, Connec	1.00000000	1.00000	EA
1	Asm	19	.PCA045	A		Assy, PCT, Motor Controller Bo	1.00000000	1.00000	EA
1	Asm	20	.BGP1501	A		Brushless Thruster 100, Prop E	1.00000000	1.00000	EA
1	Mtl	21	.LB301	B		Label, Serial Number	1.00000000	1.00000	EA
1	Mtl	22	.FN101			Washer, Seal, Nylon	2.00000000	2.00000	EA
1	Mtl	23	.FN310			Screw, # 4 x 5/8", Thread Form	1.00000000	1.00000	EA
1	Mtl	24	.LU003	A		Oil, Mineral Lite	0.10000000	0.10000	LT
1	Mtl	25	.FN029			Screw, 10-32 x 1/8", Silicone	1.00000000	1.00000	EA
1	Mtl	100	.SS081			Syringe, 10cc	0.00000001	0.00000	EA

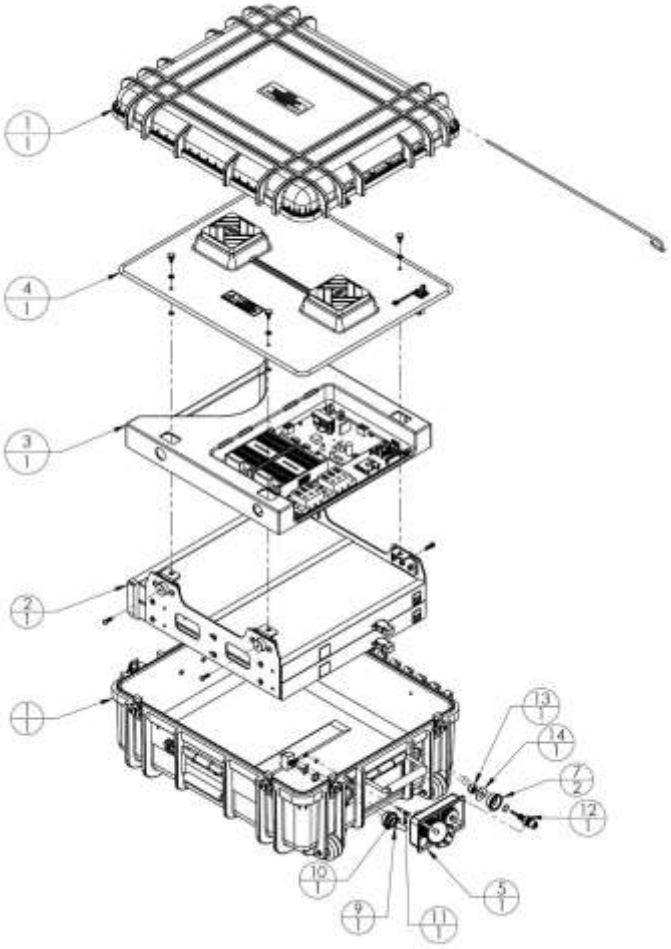
16.1.3 Tilt Mechanism



Lvl	Typ	Seq	Part Number	Revision	Alt	Description	Qty/Parent	Required Qty	UM
			TLM001	A		Tilt Mechanism, vLBV		1.00000	EA
1	Asm	1	.MHA002	C		Motor Housing, Tilt Assembly	1.00000000	1.00000	EA
1	Asm	2	.OCA1500	G		Assembly, Oil Compensation Tub	1.00000000	1.00000	EA
1	Asm	3	.DSC003	A		Drive Shaft Coupling, Camera A	1.00000000	1.00000	EA
1	Asm	4	.DSC002	A		Drive Shaft Coupling, Light Ax	2.00000000	2.00000	EA
1	Mtl	5	.ML803			Timing Belt, 2.03 Pitch, 64 Gr	2.00000000	2.00000	EA
1	Mtl	6	.MA1030	A		Tilt Axle, Camera, Bearing, Su	4.00000000	4.00000	EA
1	Mtl	7	.ML802			Flanged Bearing, 12mm ID, Spli	2.00000000	2.00000	EA
1	Mtl	8	.MA1031	B		Tilt Axle, Light, Bearing Supp	4.00000000	4.00000	EA
1	Mtl	9	.ML801			Flanged Bearing, 8mm ID, Split	4.00000000	4.00000	EA
1	Mtl	10	.FN824			Dowel Pin, M4x12mm, 316SS	4.00000000	4.00000	EA
1	Mtl	11	.FN823			Washer, 9mm x 15.875 mm x 2.54	4.00000000	4.00000	EA
1	Mtl	12	.MA1032	A		Flanged Mount, ELS, Tilt Mecha	4.00000000	4.00000	EA
1	Mtl	13	.FN878			Screw, M5 x 30mm PHPMS, Polyca	10.00000000	10.00000	EA



16.2 Exploded Diagram SPS3020EH

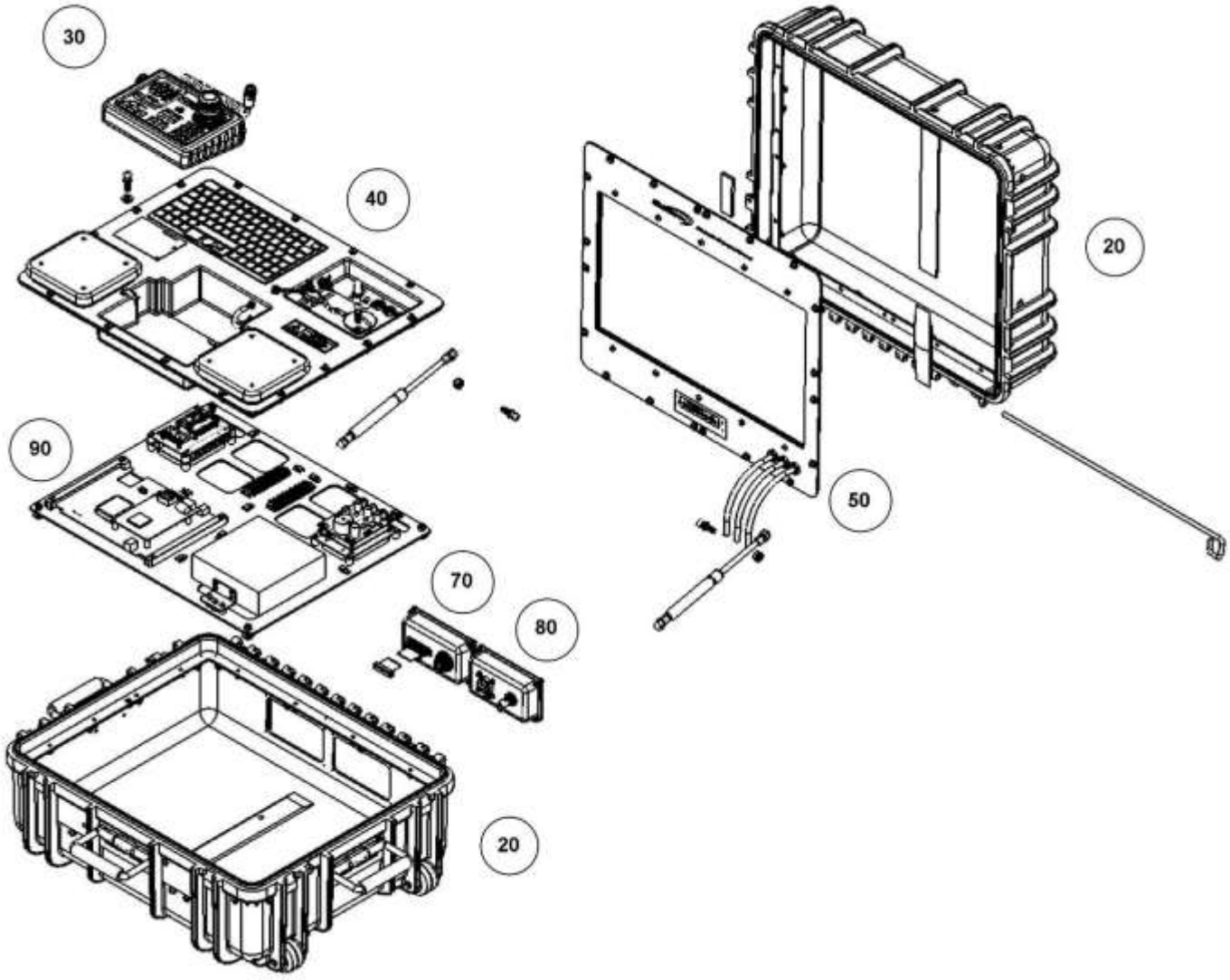


16.2.1 SPS3020EH Parts List

Prog: bmr30 SeaBotix, Inc. Page: 1
User: Markp BILL OF MATERIAL REPORT Date: 11/04/13
SINGLE LEVEL Time: 3:10 pm

Lvl	Typ	Seq	Part Number	Revision	Alt	Description	Qty/Parent	Required Qty	UM
			SPS3020EH	B		Surface Power Supply, 3000 W,		1.00000	EA
1	Asm	1	.CAS002	B		Assembly, 822 Lower Case, SPS3	1.00000000	1.00000	EA
1	Asm	2	.TSP001	A		Assembly, Power Supply, SPS300	1.00000000	1.00000	EA
1	Asm	3	.EPA055	B		Electronic Panel Assembly, SPS	1.00000000	1.00000	EA
1	Mtl	4	.LPA023	A		Upper Panel Assembly, Fan Hous	1.00000000	1.00000	EA
1	Asm	5	.IOA031	A		Input Output Assembly, SPS3000	1.00000000	1.00000	EA
1	Mtl	6	.EC1518			Waterproof Panelmnt .Fuse Hold	1.00000000	1.00000	EA
1	Mtl	7	.MA1608	A		Socket, Connector Relief	2.00000000	2.00000	EA
1	Mtl	8	.SW012			Toggle Switches DPST, ON-OFF,	1.00000000	1.00000	EA
1	Mtl	9	.ML101			Boot, Toggle Switch, 21.44mm	1.00000000	1.00000	EA
1	Mtl	10	.LI101			LED, Power Indicator, RED	1.00000000	1.00000	EA
1	Mtl	11	.LI102			LED, Status Indicator, ORG	1.00000000	1.00000	EA
1	Mtl	12	.CN017			Connector, 8 Contact, Female,	1.00000000	1.00000	EA
1	Mtl	13	.FN715			Nut 7/16-20, Nyloc, 18-8 SS	1.00000000	1.00000	EA
1	Mtl	14	.FN714			Washer, 7/16", 18-8 SS	1.00000000	1.00000	EA
1	Mtl	15	.LB819	A		Label, Power, SPS3020EH	1.00000000	1.00000	EA
1	Mtl	16	.LB820	A		Label, Umbilical, SPS3020EH	1.00000000	1.00000	EA

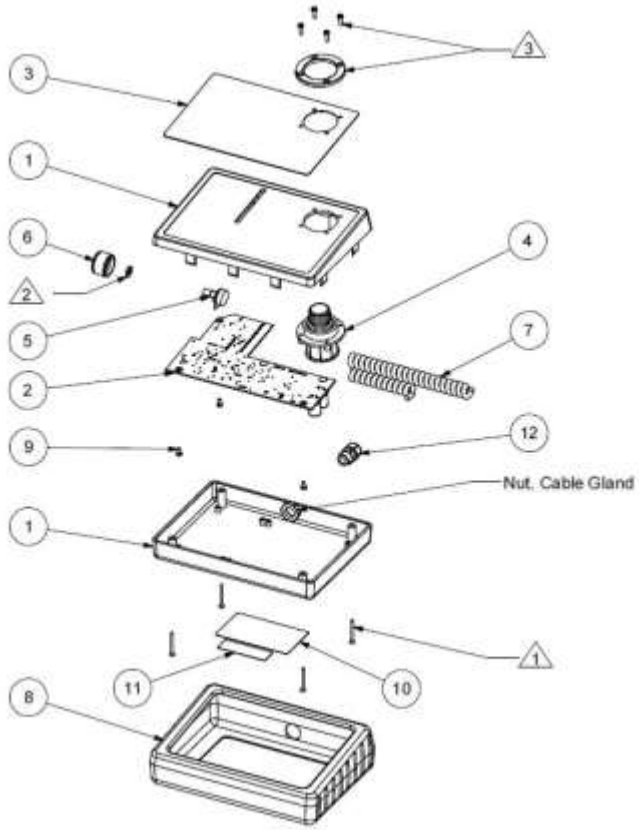
6.3 Exploded Diagram INC



Prog: bmr30 — SeaBotix, Inc. — Page: 1
User: Markp — BILL OF MATERIAL REPORT — Date: 11/04/13
SINGLE LEVEL — Time: 3:06 pm

Lvl	Typ	Seq	Part Number	Revision	Alt	Description	Qty/Parent	Required Qty	UM
			INC300	B		Integrated Navigation Control		1.00000	EA
1	Asm	10	.FNK251	R		Fabrication Fastener Kit, INC1	1.00000000	1.00000	EA
1	Asm	20	.MA820	C		Case, Modified, INC150	1.00000000	1.00000	EA
1	Asm	30	.CCA010	C		Operator Control Unit, vLBV	1.00000000	1.00000	EA
1	Asm	40	.LPA024	B		Lower Panel Assembly, INC300	1.00000000	1.00000	EA
1	Asm	50	.UPA007	D		Upper Panel Assembly, INC150,	1.00000000	1.00000	EA
1	Mtl	60	.SL046			Seal, Rubber Washer, #10, EPDM	4.00000000	4.00000	EA
1	Asm	70	.IOA032	B		Input Output Panel, INC300	1.00000000	1.00000	EA
1	Asm	80	.IOA033	B		Input Output Assembly, Comms-T	1.00000000	1.00000	EA
1	Asm	90	.EPA058	B		Electronic Panel Assembly, INC	1.00000000	1.00000	EA
1	Mtl	100	.SL116	A		Gasket, Upper Panel Ring, INC	1.00000000	1.00000	EA
1	Mtl	110	.FN701			Washer, Flat, #10, 18-8 SS	8.00000000	8.00000	EA
1	Mtl	120	.FN122			Screw, M5 x 35, Button Head	4.00000000	4.00000	EA
1	Mtl	130	.FN066			Nut, M5, 18-8SS	4.00000000	4.00000	EA
1	Mtl	140	.FP826	B		Ballast, Grabber, 300 gr., S.S	4.00000000	4.00000	EA

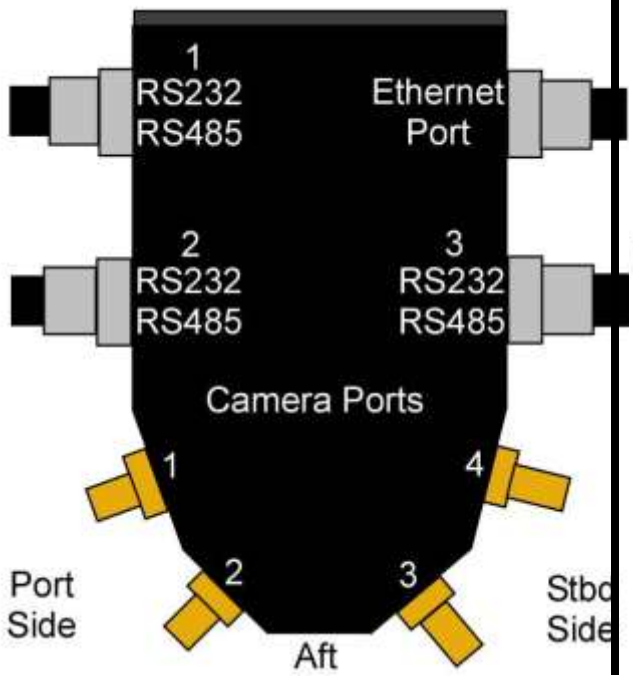
16.4 OCU (Operator Control Unit) CCA001



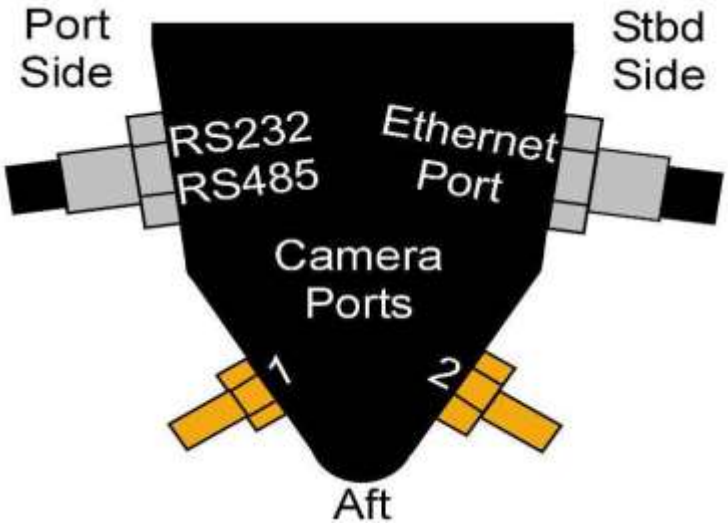
Lvl	Typ	Seq	Part Number	Revision	Alt	Description	Qty/Parent	Required Qty	UM
			CCA001	C		Operator Control Unit, ICC150,		1.00000	EA
1	Mtl	10	.CB029			Wire, WHT 24AWG, Teflon Strand	0.67000000	0.67000	FT
1	Mtl	20	.CB035			Wire, RED 24AWG, Teflon Strand	0.50000000	0.50000	FT
1	Mtl	30	.CB050			Wire, BLU 24AWG, Teflon Strand	1.00000000	1.00000	FT
1	Mtl	40	.CB053			Wire, BLK 24AWG, Teflon Strand	0.50000000	0.50000	FT
1	Asm	50	.CBA115	B		Retractable Cable, Operator Co	1.00000000	1.00000	EA
1	Mtl	60	.CN012			Conn, Header, 3 Pos, Vertical,	1.00000000	1.00000	EA
1	Mtl	70	.CN013			Conn, Receptacle, 3 Pos, 24 Aw	1.00000000	1.00000	EA
1	Mtl	80	.CN171			Connector, Dust Cover 8 Pos, C	1.00000000	1.00000	EA
1	Mtl	90	.CN316			Conn, Receptacle, 8 Pos, 24 Aw	1.00000000	1.00000	EA
1	Mtl	100	.EC008			Capacitor, Ceramic, 0.1 uF, 50	1.00000000	1.00000	EA
1	Mtl	110	.EC009	A		Pot, 100K, 1 Turn, VPTC	1.00000000	1.00000	EA
1	Asm	120	.EC303	A		IC, MCU, PIC17C56A-33I/L, Prog	1.00000000	1.00000	EA
1	Mtl	130	.FN325			Screw, M3 x 5, Phillips Pan He	2.00000000	2.00000	EA
1	Mtl	140	.FN343			Standoff, M3 x 5, Hex, F/F	1.00000000	1.00000	EA
1	Mtl	150	.FN371			Screw, M3 x 12, Phillips Pan H	5.00000000	5.00000	EA
1	Mtl	160	.FP039	A		PIC, Securing Tab	1.00000000	1.00000	EA
1	Mtl	170	.LB201	B		Label, Control Console	1.00000000	1.00000	EA
1	Mtl	180	.LB301	B		Label, Serial Number	1.00000000	1.00000	EA
1	Mtl	190	.MA043	A		Knob, Control Console, Gen 2	1.00000000	1.00000	EA
1	Mtl	200	.MA202	B		Case, Control Console, Mod, Ge	1.00000000	1.00000	EA
1	Mtl	210	.ML016			Gland, Cable, BLK	1.00000000	1.00000	EA
1	Mtl	220	.ML204	D		Boot, Control Console	1.00000000	1.00000	EA
1	Asm	230	.PCA008	G		Assy, PCT, Operator Control Un	1.00000000	1.00000	EA
1	Mtl	240	.SS035			Heat shrink, 3/8" OD, 2:1 Blac	0.16666666	0.16667	FT
1	Mtl	250	.SW208	B		Keypad, Control Console, Engli	1.00000000	1.00000	EA
1	Mtl	260	.SW210			Joystick, Control Console, Tal	1.00000000	1.00000	EA

Addendum A: Standard vLBV Port Manifold Connections

MAN001 Eight Port Manifold
Forward



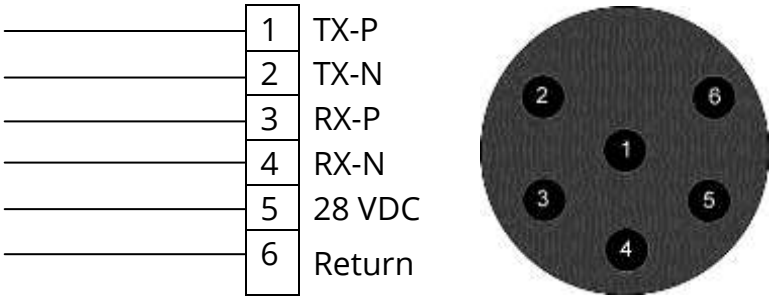
MAN002 Four Port Manifold
Forward



Addendum B: Video Bulkhead Connection Wiring Diagram.

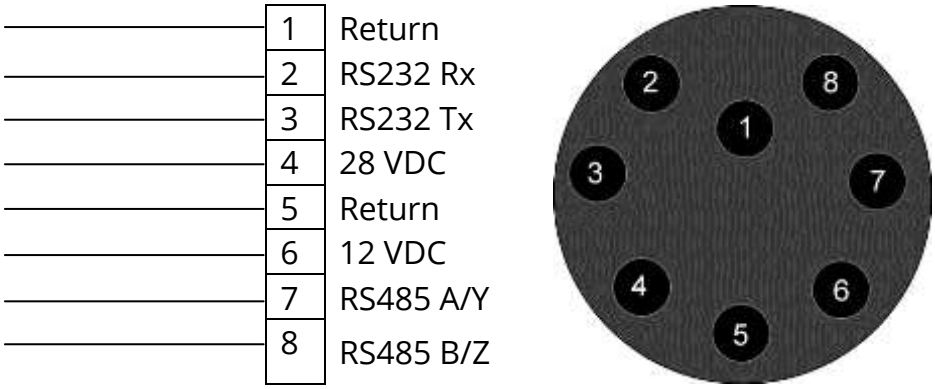
1	Return
2	12 VDC
3	Video
4	RX
5	TX

ddendum C: Ethernet bulkhead Connection Wiring Diagram.



Face View

Addendum D: Serial Port RS232 / RS485 Bulkhead Connection Wiring Diagram.



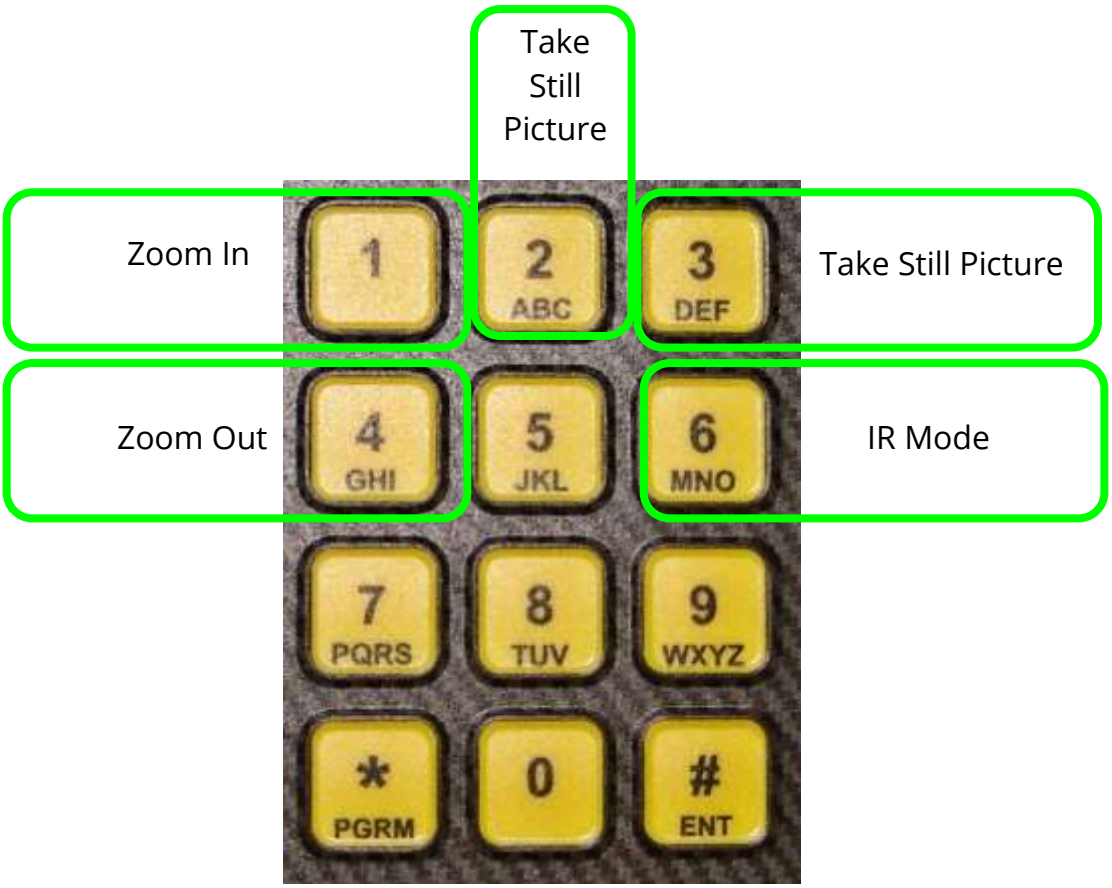
Face View

Addendum E: SubC 1CamX HD Camera Controls

The SubC 1CamX HD camera is controlled via keypad entry on the Operator Control Unit.

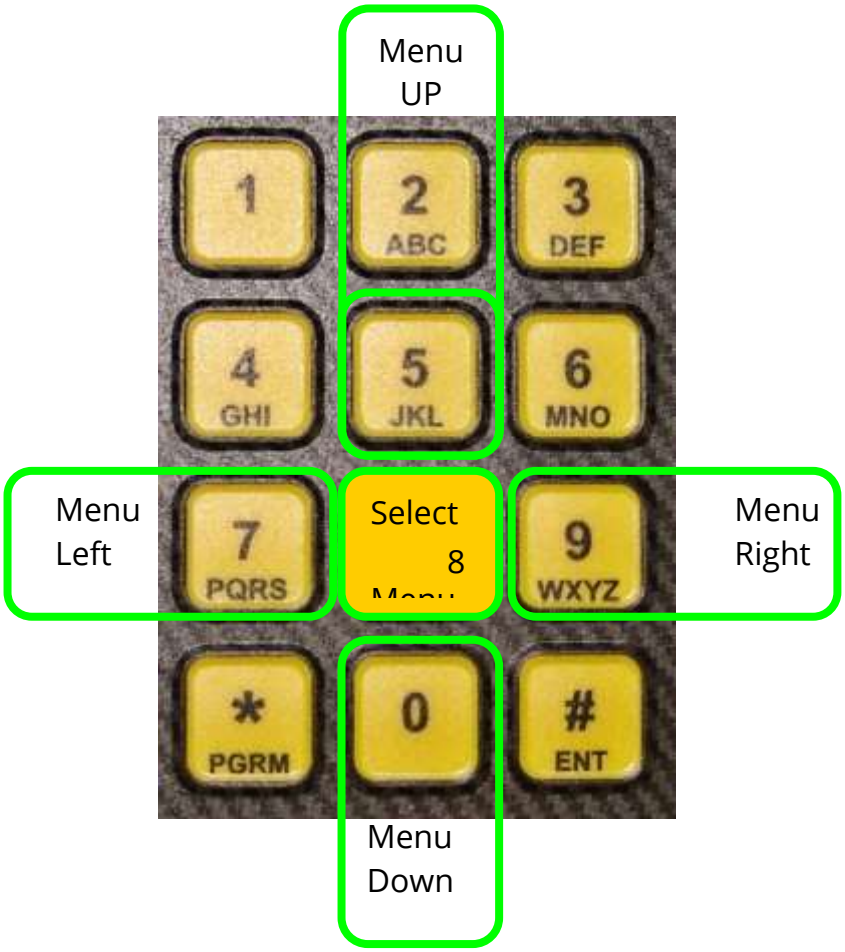
To activate the controls, the operator will select HD via the SELECT button on the Operator Control Unit. Once HD is displayed in the selected accessory position on the video overlay, the operator can utilize the numeric keypad of the Operator Control Unit to control the available functions of the camera as shown in the tables below.

A. Camera Operational Controls



NOTE: There are no on screen indicators that a picture has been taken or that recording is in progress.

B: Camera Menu Access and controls



C: Setting up SubC 1CamX for operation and control

Step	Action		
1	Press *	* PGRM	Open vLBV Menu Screen
2	Press 0	0	Select Main Menu
3	Press 4	4 GHI	Select Options
4	Press 5	5 JKL	Select Camera Type
5	Press 5	5 JKL	Select Zoom
6	Press 3	3 DEF	Select HD
7	Press #	# ENT	Enter
8	Press *	* PGRM	Exit Menu

D: Selecting the 1CamX for display:

Press and hold the camera button on the OCU

Select Number 5 on the keypad

Refer to Section 2.17 of this manual for additional information on camera selection.

Addendum F: ARIS Tool Skid

With the ARIS Tool Skid option, the operator can roll the sonar head up to 90^{o} either port or starboard. The skid also allows the operator to pitch the sonar head up or down up to 25^{o}. This allows the operator to obtain greater target definition and increases system flexibility for investigating sonar targets

The tilt and roll functions of the Tool Skid are controlled via the ACCESSORIES selection of on the Operator Control Unit.

A. Roll Control

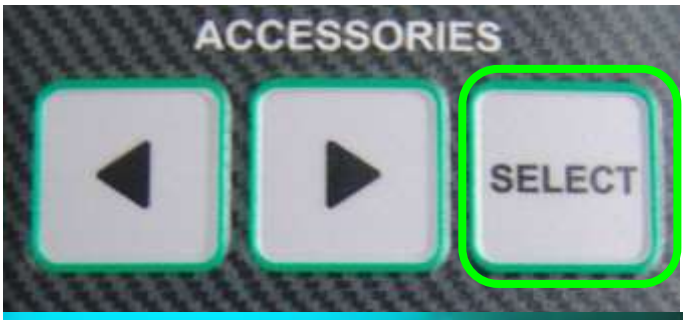
Press the SELECT button on the Operator Control Unit

Verify that the overlay shows RS in the accessory position

The left arrow will roll the sonar to port and the right arrow will roll the sonar to starboard

B. Pitch Control

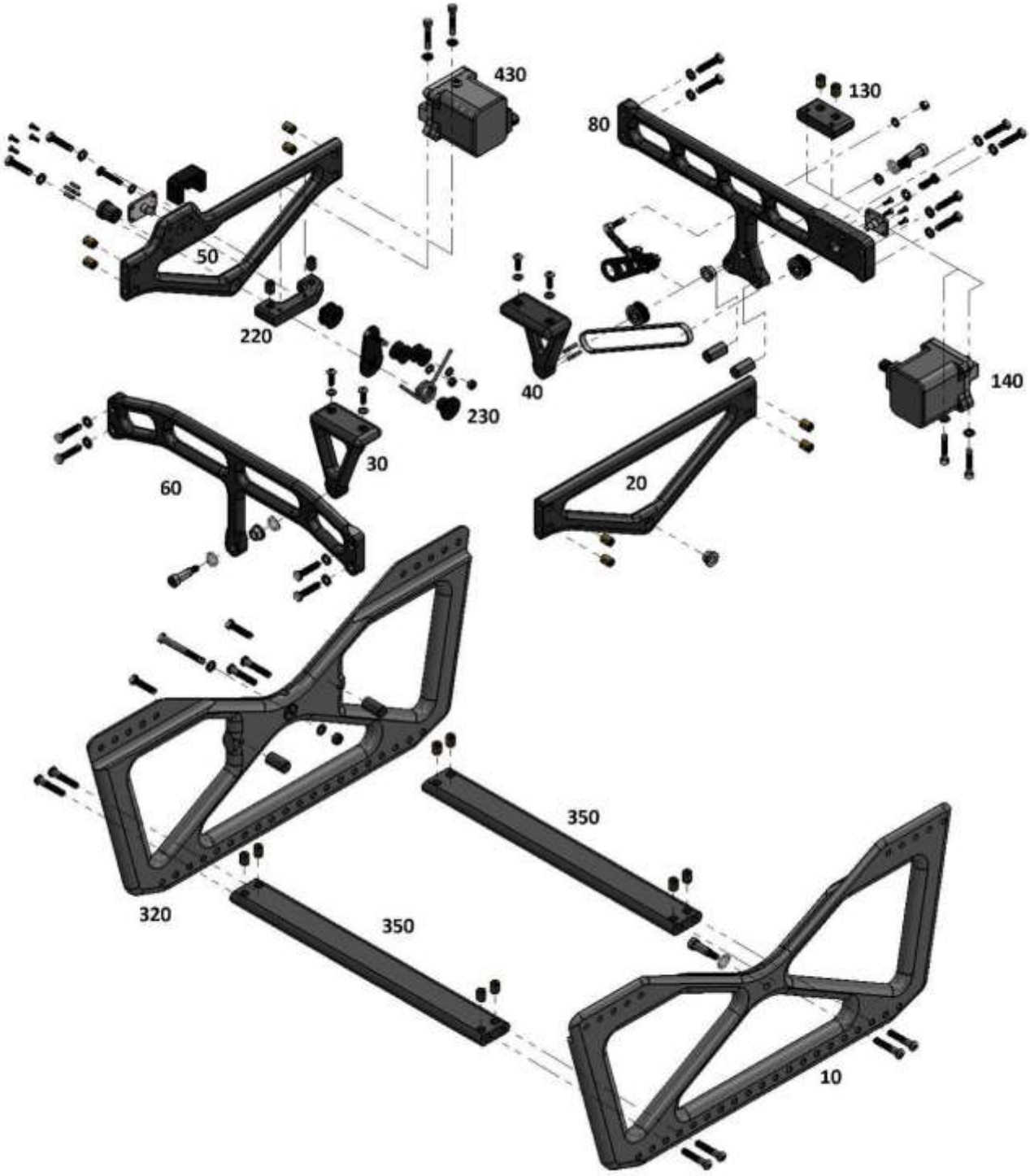
Press the SELECT button on the Operator Control Unit



Verify that the overlay shows PS in the accessory position

The left arrow will pitch the sonar down and the right arrow will pitch the sonar up

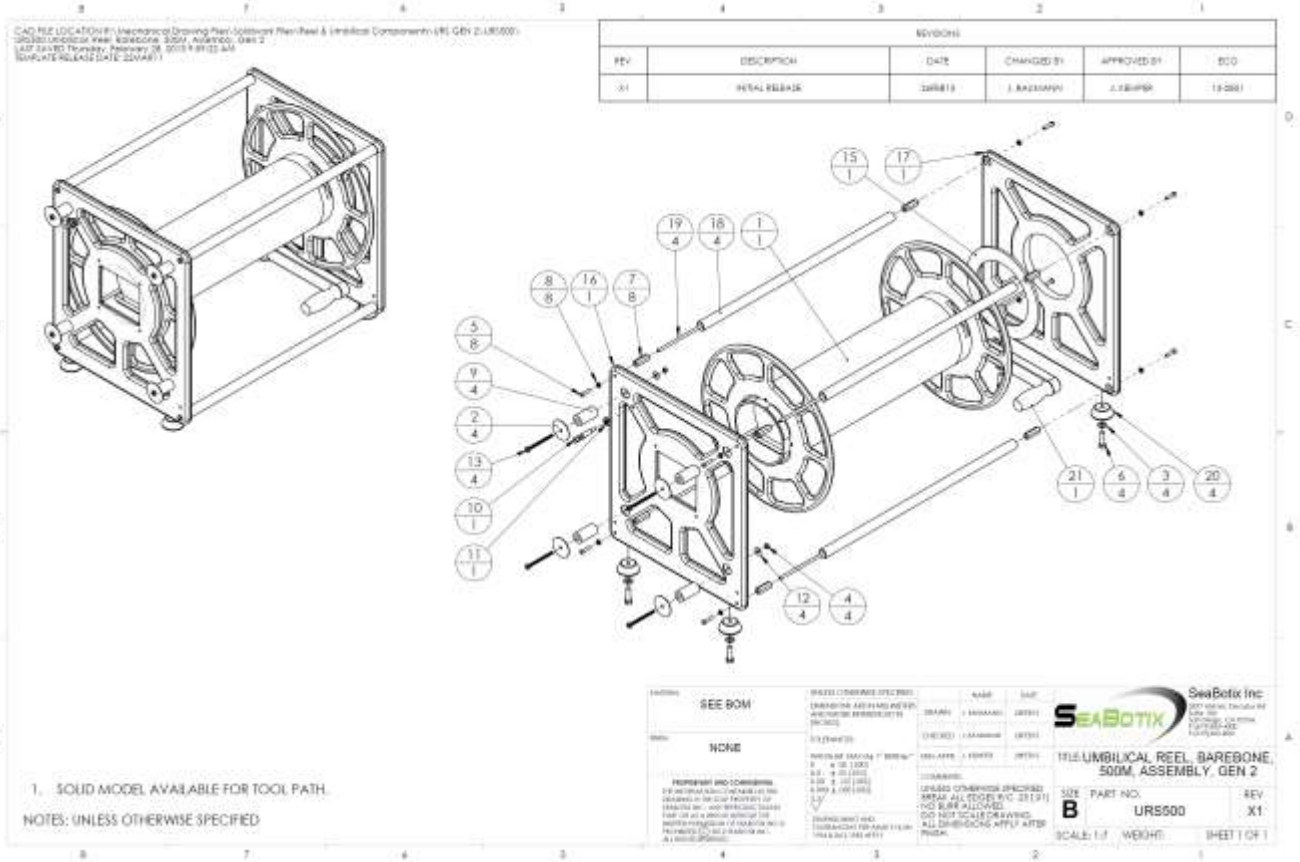
C. Exploded Parts Diagram



D. Parts List

Lvl	Typ	Seq	Part Number	Revision	Alt	Description	Qty/Parent	Required Qty	UM
			RFA001	B		Rotator Frame Assembly		1.00000	EA
1	Mtl	10	.MA1501	A		Bracket, Side, Skid, Lower, Le	1.00000000	1.00000	EA
1	Mtl	20	.MA1500	A		Bracket, Rotator, Left, Skid	1.00000000	1.00000	EA
1	Mtl	30	.MA1498	A		Bracket, Front, Rotator	1.00000000	1.00000	EA
1	Mtl	40	.MA1508	A		Bracket, Rear, Rotator	1.00000000	1.00000	EA
1	Mtl	50	.MA1510	B		Bracket, Rotator, Right, Skid	1.00000000	1.00000	EA
1	Mtl	60	.MA1499	B		Bracket, Rotator, Front, Skid	1.00000000	1.00000	EA
1	Mtl	70	.FN853			Washer, 8mm, Wave, SS	4.00000000	4.00000	EA
1	Mtl	80	.MA1509	B		Bracket, Rotator, Rear, Skid	1.00000000	1.00000	EA
1	Mtl	90	.FN264			Dowel Pin, 3mm X 12mm, 316 SS	12.00000000	12.00000	EA
1	Mtl	100	.FN262			Bearing, Flanged, 8mm ID, 12mm	3.00000000	3.00000	EA
1	Mtl	110	.MA1507	A		Pulley, Pin, T2.5, 28 Groove,	2.00000000	2.00000	EA
1	Mtl	120	.MA1513	A		Block, Stop	4.00000000	4.00000	EA
1	Mtl	130	.MA1506	A		Bracket, Motor Adaptor	1.00000000	1.00000	EA
1	Asm	140	.MHA003	C		Motor Housing, Roll Assembly w	1.00000000	1.00000	EA
1	Mtl	150	.FN690			Bolt, M5 x 30mm, SHCS 316 SS	4.00000000	4.00000	EA
1	Mtl	160	.MA1505	A		Bracket, Pulley, C, ROV Frame	1.00000000	1.00000	EA
1	Mtl	180	.MA1496	A		Pulley, Drive, T2.5, 28 Groove	1.00000000	1.00000	EA
1	Mtl	190	.ML432			Belt, Timing, T2.5, 152 Teeth,	1.00000000	1.00000	EA
1	Mtl	200	.MA1503	A		Bracket, Pulley, A, ROV Frame	1.00000000	1.00000	EA
1	Mtl	210	.MA1497	A		Pulley, Drive, T2.5, 19 Groove	1.00000000	1.00000	EA
1	Mtl	220	.MA1531	A		Motor Mount, Starboard Side, A	1.00000000	1.00000	EA
1	Mtl	230	.MA1533	A		Pivot Axle, Starboard Side, AR	1.00000000	1.00000	EA
1	Mtl	240	.FN250			Screw, M6 X 50, BHCS, 18-8 Sta	1.00000000	1.00000	EA
1	Mtl	250	.FN323			Nut, M6, Nyloc	1.00000000	1.00000	EA
1	Mtl	260	.ML435	A		Belt, 2.5 Pitch X 330mm Pitch	1.00000000	1.00000	EA
1	Mtl	270	.FN422			Washer, .2" ID, .44" OD, Plast	4.00000000	4.00000	EA
1	Mtl	280	.FN387			Screw, M6 x 20, Button Head 18	2.00000000	2.00000	EA
1	Mtl	290	.FN692			Washer, M5, 10mm OD, 316 SS	4.00000000	4.00000	EA
1	Mtl	300	.FN833			Washer, M6, Flat, 316SS	18.00000000	18.00000	EA
1	Mtl	310	.FN836			Screw, M3-0.5 x 30mm, FHCS, 31	8.00000000	8.00000	EA
1	Mtl	320	.MA1502	A		Bracket, Side, Skid, Lower, Ri	1.00000000	1.00000	EA
1	Mtl	340	.FN260			Insert, M6 X 9mm, Brass	22.00000000	22.00000	EA
1	Mtl	350	.MA1512	A		Bar, Spreader, ROV Frame	2.00000000	2.00000	EA
1	Mtl	360	.FN224			Screw, M6 X 30 BSHC, 316 SS	14.00000000	14.00000	EA
1	Mtl	380	.FN391			Screw, M5 x 16, Button Head 18	4.00000000	4.00000	EA
1	Mtl	400	.FN266			Screw, M6 X 20mm, SHCS, 8mm Sh	3.00000000	3.00000	EA
1	Mtl	420	.FN395			Screw, M6 x 35, Button Head	8.00000000	8.00000	EA
1	Asm	430	.MHA004	D		Motor Housing, Pitch Assembly,	1.00000000	1.00000	EA

Addendum H: The URS



Lvl	Typ	Seq	Part Number	Revision	Alt	Description	Qty/Parent	Required Qty	UM
			URS250	B		Umbilical Reel, Barebone, 250M		1.00000	EA
1	Asm	10	.DRA601	A		Drum Assy, URS250, Gen 2	1.00000000	1.00000	EA
2	Mtl	10	..AD004			Cement, PVC, Clear 16 oz	1.60000000	1.60000	OZ
2	Mtl	20	..FN128			Screw, M3 X 20, Phillips Flat	8.00000000	8.00000	EA
2	Mtl	30	..FN206			Screw # 6 x .5" Philliips Pan	1.00000000	1.00000	EA
2	Mtl	40	..FN725			Screw, Set, M6 x 12, Cone Poin	4.00000000	4.00000	EA
2	Mtl	50	..MA626	E		Stop Pullout, URS, Gen 2	2.00000000	2.00000	EA
2	Mtl	60	..MA633	A		Flange Drum, URS, Gen 2	2.00000000	2.00000	EA
2	Mtl	70	..MA634	B		Hub Handle, URS, Gen 2	1.00000000	1.00000	EA
2	Mtl	80	..MA635	A		Drum Reel, URS 250, Gen 2	1.00000000	1.00000	EA
2	Mtl	90	..MA685	E		Drum End , Hub, URS175M, Gen 2	1.00000000	1.00000	EA
2	Mtl	100	..MA686	D		Drum End , Handle , URS175M, G	1.00000000	1.00000	EA
2	Mtl	110	..SS171			Primer, PVC, 16 Ounce	0.25000000	0.25000	GR
2	Mtl	120	..SS613			Cable Strap, Nylon, 5/16"	1.00000000	1.00000	EA
1	Mtl	20	.FN003			Washer, Fender, 1/4", Flat, SS	4.00000000	4.00000	EA
1	Mtl	30	.FN131			Washer, M10, 316 SS	4.00000000	4.00000	EA
1	Mtl	40	.FN353			Nut, M6	4.00000000	4.00000	EA
1	Mtl	50	.FN388			Screw, M6 x 25, Button Head	8.00000000	8.00000	EA
1	Mtl	60	.FN611			Screw, 3/8"-16 Hex Bolt 1 1/4"	4.00000000	4.00000	EA
1	Mtl	70	.FN623			Coupling Nut, M6 x 1, SST	8.00000000	8.00000	EA
1	Mtl	80	.FN624			Washer, M6, 18-8 SS	8.00000000	8.00000	EA
1	Mtl	90	.FN629			Standoff, OD 1.00 x ID 0.510,	4.00000000	4.00000	EA
1	Mtl	100	.FN640			Plunger, L-Handle-Locking, M10	1.00000000	1.00000	EA
1	Mtl	110	.FN655			Nut, thin, M10x 1.5, SST	1.00000000	1.00000	EA
1	Mtl	120	.FN658			Washer, M6, Fender, 18-8 SS	8.00000000	8.00000	EA
1	Mtl	130	.FN660			Screw, M6 x 75, Button Head So	4.00000000	4.00000	EA
1	Mtl	140	.LU002	A		Lubricant, Gel Lube	0.50000000	0.50000	OZ
1	Mtl	150	.MA427	B		Spacer Ring, URS, 1/4"	1.00000000	1.00000	EA
1	Mtl	160	.MA638	D		Base, Reel, Slip Ring End, URS	1.00000000	1.00000	EA
1	Mtl	170	.MA639	D		Base, Reel, Handle End, URS, G	1.00000000	1.00000	EA
1	Asm	180	.MA650	B		Support Tube, URS250, Gen 2	4.00000000	4.00000	EA
2	Mtl	10	..FN601			Tubing, Stainless T- 304 .875	1.20000000	4.80000	FT
1	Asm	190	.MA660	B		Threaded Rod, M6, 250 Meters,	4.00000000	4.00000	EA
2	Mtl	10	..FN603			Threaded Rod, M6 x 1	0.31750000	1.27000	M
1	Mtl	200	.ML015	A		Feet, Neoprene, Dampener	4.00000000	4.00000	EA
1	Mtl	210	.ML017	A		Handle, Winch, 8", RED/BLK, UR	1.00000000	1.00000	EA
1	Mtl	220	.SS014			Strap, Velcro, BLK, 8" L x 3/4	2.00000000	2.00000	EA
1	Mtl	230	.SS099			Loctite, 262, Red, High Streng	0.05000000	0.05000	EA

Addendum I: Power Management Settings vs. Tether Length

The purpose of this addendum is to enable the user to control the power limit settings inside the vLBV.

With longer tethers, it is possible for the system to draw more current than can be provided thru the tether with the result being insufficient power delivered to the vLBV.

The effect is a power reboot of the vLBV when voltage drops below the threshold needed to power the vLBV internal power supplies.

To prevent this follow the instructions below for each tether length

350 meter tether length

A		Turn on the system Select the PGM (*) key to bring up the menu options page Enter 83 to bring up the Vehicle Power Menu Select menu option 1.
B		Type 1400 Press enter (#) to set the new value Select menu option 1 to verify the setting Press the * key to return to vLBV operations

500 meter tether length

A		Turn on the system Select the PGM (*) key to bring up the menu options page Enter 83 to bring up the Vehicle Power Menu Select menu option 1.
B		Type 1400 Press enter (#) to set the new value Select menu option 1 to verify the setting Press the * key to return to vLBV operations

750 meter tether length

A		Turn on the system Select the PGM (*) key to bring up the menu options page Enter 83 to bring up the Vehicle Power Menu Select menu option 1.
B		Type 1000 Press enter (#) to set the new value Select menu option 1 to verify the setting Press the * key to return to vLBV operations

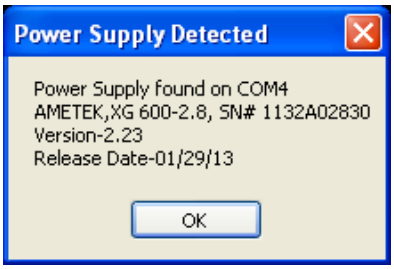
1250 meter tether length

		Turn on the system Select the PGM (*) key to bring up the menu options page Enter 83 to bring up the Vehicle Power Menu Select menu option 1.
		Type 800 Press enter (#) to set the new value Select menu option 1 to verify the setting Press the * key to return to vLBV operations

Addendum J: Programming the AMETEK Power Supplies

A: Master AMETEK Setup

NOTICE	DO NOT click the "RESET TO DEFAULT" button! Equipment damage may result.

A.1: Measure the resistance of each primary lead Pins 2 & 3 of the tether with a multi-meter from one end of the tether to the other	1.a Pin 2-2 resistance _____ Ω (Ohms) 1.b Pin 3-3 resistance _____ Ω (Ohms)
A.2: Install SPS Programmer	This software is installed at the factory for all systems delivered with the INC. The software will be found in the start menu in the SeaBotix folder
A.3: Setting up the Master AMETEK	**a.** Connect Master AMETEK to PC/INC via USB A-A cable **b.** Turn on AMETEK
A.4: Configure Master AMETEK Using SPS Programmer a. Open SPS Programmer **b.** Select Master. Click **"Open Connection"** - Message will appear asking you to confirm that the AMETEK is connected via USB cable. Click **OK**. - Programmer will search for the connected AMETEK - SPS Programmer will connect to AMETEK and display this message - Click **OK**.	 NOTE: SN# and Version will be different from the example above. This information is unique to each AMETEK
A.5: Input values for the Master AMETEK (fields highlighted in green.)	**a.** Input all fields EXAMPLE:

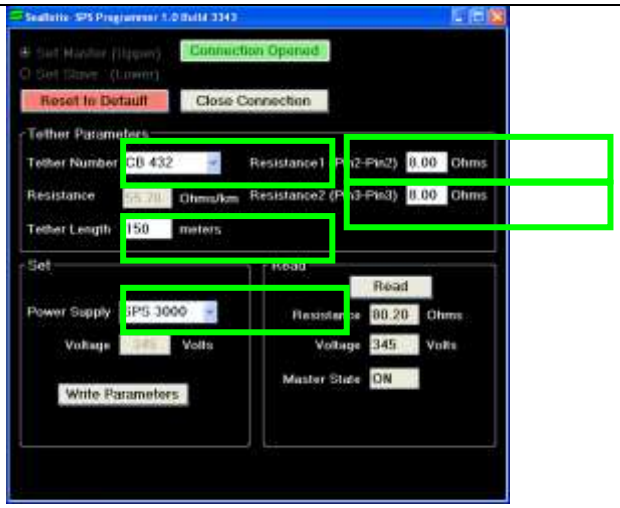
Tether number can be found printed on the jacket of the tether

Tether length can be found on your sales order, or if repaired, on the repair work order

Enter the value measured in Step 1.a in the block for Resistance 1

Enter the value measured in Step 1.b in the block for resistance 2

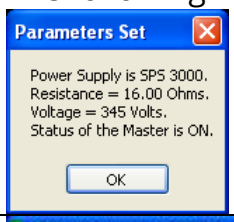
	NOTE: Ignore any information displayed in the "Read" box.



A.6: Click "Write Parameters"

Click **OK**.

The following message will be displayed.



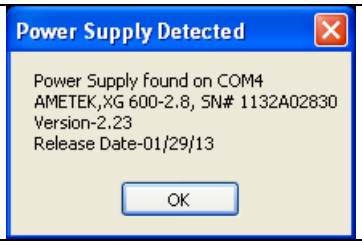
A.7: After you click **OK** the information in the "**Read**" box should match the information you entered in the other boxes.

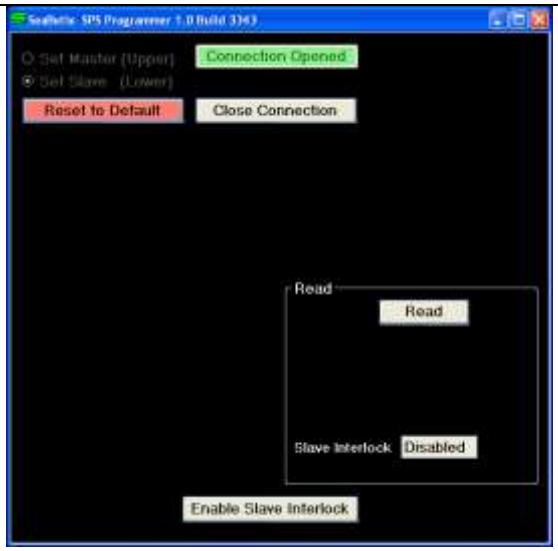
	Resistance should equal the sum of Resistance 1 and 2 in the **"Tether Parameters"** Box.

	If only installing a new length tether to the system, do not perform procedure B: Setting up the Slave Power Supply go directly to procedure C: Verifying Voltage

B: Slave AMETEK Setup

	NOTE: Follow these steps after installing NEW or replacement AMETEKS ONLY. Do not perform these steps if only changing tether length
B.1: Install SPS Programmer	This software is installed at the factory for all

	systems delivered with the INC. The software will be found in the start menu in the SeaBotix folder
B.2: Setting Up the Slave AMETEK	**a.** Connect Slave AMETEK to PC via USB **b.** Turn on AMETEK
B.3: Configure Slave AMETEK Using SPS Programmer	**a.** Open SPS Programmer **b.** Select Slave. c. Click "Open Connection" - Message will appear asking you to confirm that the AMETEK is connected. Click **OK**. - Programmer will search for the connected AMETEK
B.4: SPS Programmer will connect to AMETEK and display the following message. Click **OK**	

B.5: Click "Reset to Default"	 You will be asked to confirm reset. Click "**OK**

C: Verify Voltage and Current Output

C.1 Connect tether to SPS

NOTICE

Do not connect the vehicle prior to performing these tests. Equipment damage could result

C.2 Turn on SPS as per instruction manual.

- Power up the system by pressing the power button on the OCU (Operator Control Unit)

C.3 Display Voltage should read approximately 345v

C.4 Display Current should read approximately 0 amps

C.5 Take voltage reading at the wet end of tether between Socket 2 (black lead) and Socket 3 (red lead). Voltage should read approximately 345VDC +/- 1%

Note: The multi-meter must be set to read volts DC and on a scale that will read at least 360VDC.

- If voltage is incorrect verify reading and repeat programming procedure.

C.6 Shut down power. Continue to Slave AMETEK Setup if necessary.

C.7 Connect the tether to vehicle. System is ready for operation.

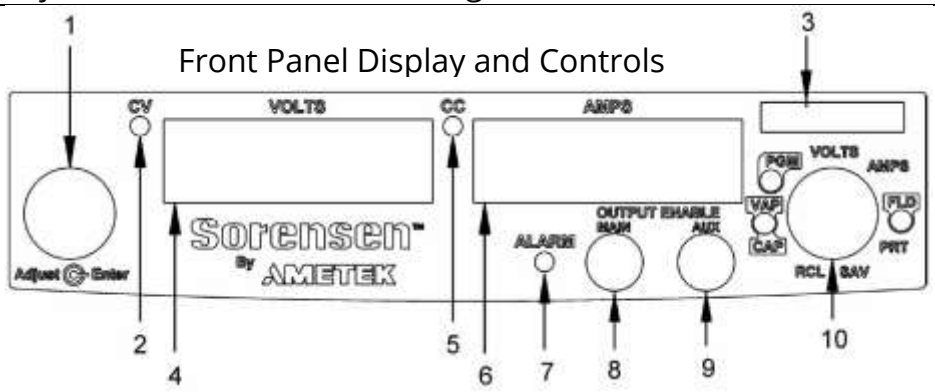
Front Panel Setup

Steps	Setting	Master	Slave
1	VOLTS	0	630
2	AMPS	2.80	2.80
3	FLD	None	None
4	PRT, OVP	630	660
5	PRT, UVP	0	0
6	PRT, OTP	OFF	OFF
7	PRT, SD	1	1
8	CAPR	OFF	OFF
9	VAPR, VNIS	OFF	OFF
10	PGM, USB	1	1
11	PGM, CURR SHAR	CONT	SLA
12	Press and hold the **OUTPUT ENABLE Main** until ***AS On*** or *AS OFF* is displayed. Set to ***AS On*** for all power supplies		
13	Press and hold the **OUTPUT ENABLE Aux** until ***AUAS On*** or *AUAS OFF* is displayed.		

	Set to ***AS On*** for all power supplies		
14	PGM, LOCLLOC	ON	ON

	NOTE: For Fine Adjust, press Adjust/Enter knob once. Press Adjust/Enter knob after entering values once more to set value.

Front Panel Display and Controls



Item Description	
1 Rotary Adjust/Enter control	**2** Constant Voltage (CV) Mode LED (green)
3 Model Identification Label	**4** Output Voltage Display
5 Constant Current (CC) Mode LED (green)	**6** Output Current Display
7 Alarm Indicator LED (red)	**8** OUTPUT ENABLE Main button
9 OUTPUT ENABLE Aux button	**10** 9-Position Mode Control (For detailed information, see “Configuring Settings from the Front Panel”)

STEP 1: Input Front Panel Settings

Input front panel setting as per table above**.**

	NOTE: This portion of the procedure only applies when required after replacement of one or both of the AMETEK power supply modules

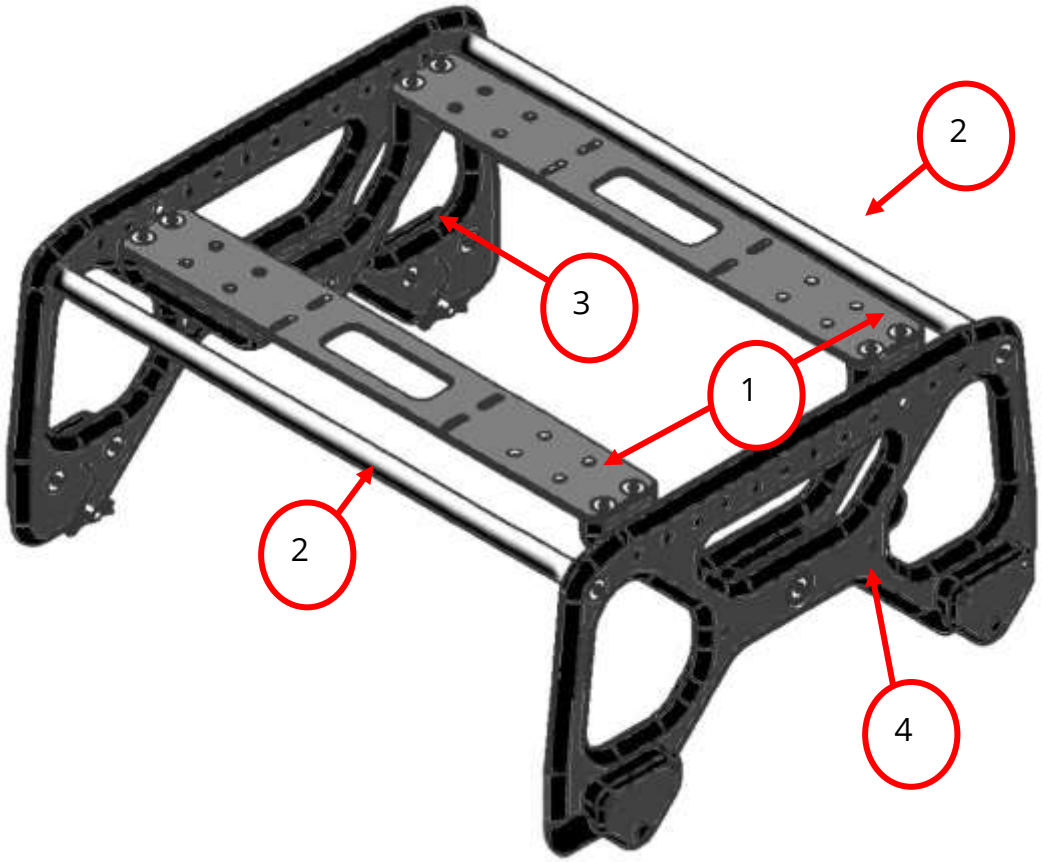
Perform A: Master AMETEK Setup

Perform B: Slave AMETEK Setup

Addendum K: Skid, Convertible, Assembly TSA004

Installation and operating instructions

K.1 Nomenclature



Top Mount View

1	Sonar Mounting Plate
2	Guard Bar
3	Pivoting Bracket Assembly
4	Bumper Frame Assembly

K.2 Installation and operating instructions

The TSA004 Skid, Convertible, Assembly is designed for use with the Gemini Multi-Beam sonar on the vLBV

Its purpose is to allow the operator to reconfigure the head quickly for either top or bottom mount without the use of hand tools.

The design allows the operator to keep the sonar head oriented as needed when mounting to the top of the bottom of the vLBV. During vLBV flight operations, the normal configuration is for the Gemini to be mounted to the bottom of the vLBV providing 0^{o} to -20^{o} vertical sonar beam coverage.

During crawler configuration use, the Gemini must be mounted on top of the vLBV.

To facilitate this shift, the TSA004 has a rotating platform that friction locks into position allowing the operator to flip the Gemini sonar head 180^{o} keeping the top up mounting orientation.

K.2.1 Top Mounting

Top mounting is used when the Crawler Skid Assembly is mounted to the vLBV.

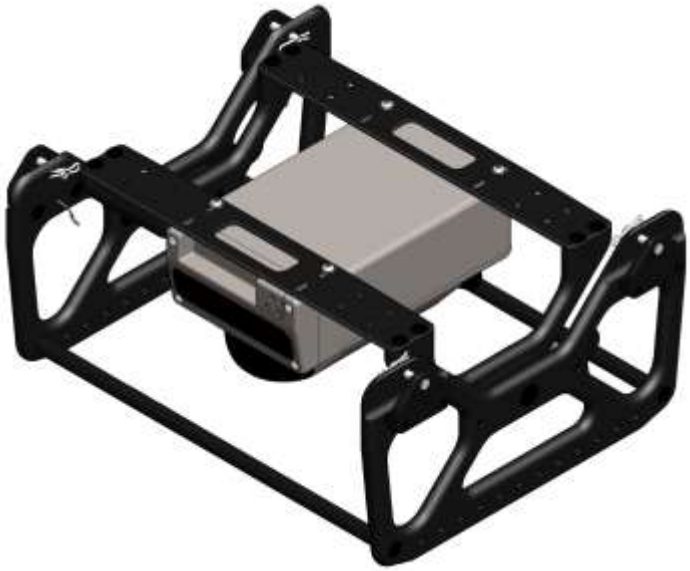
Mounting the sonar to the top of the vLBV gives the pilot a “Look Ahead” capability. This allows them to see features on the surface of the hull beyond visual camera range. Using the Look Ahead, the pilot can see weld seams on the hull and other features that can be used to assist in navigation when attached to a ship hull.

Additionally features such as sea chests and water suction/discharges are readily identifiable assisting the pilot in navigating to those features as required for inspection.

K.2.2 Bottom Mounting

The bottom mount position is the preferred mounting location for vLBV flight operations. Mounting the sonar to the bottom of the vLBV improves flight handling characteristics.

With the negative buoyancy of the sonar head mounted center below the vLBV operations are noticeably eased and stability of the vLBV is enhanced.



K.2.3 Configuring the convertible tool skid

1. To reconfigure the mount, remove it from the vLBV
2. Reach inside the frame to the two fiberglass tabs
3. Rotate the sonar head mount assembly to the desired position.
4. Once the head is in the desired position, release the fiberglass tabs.

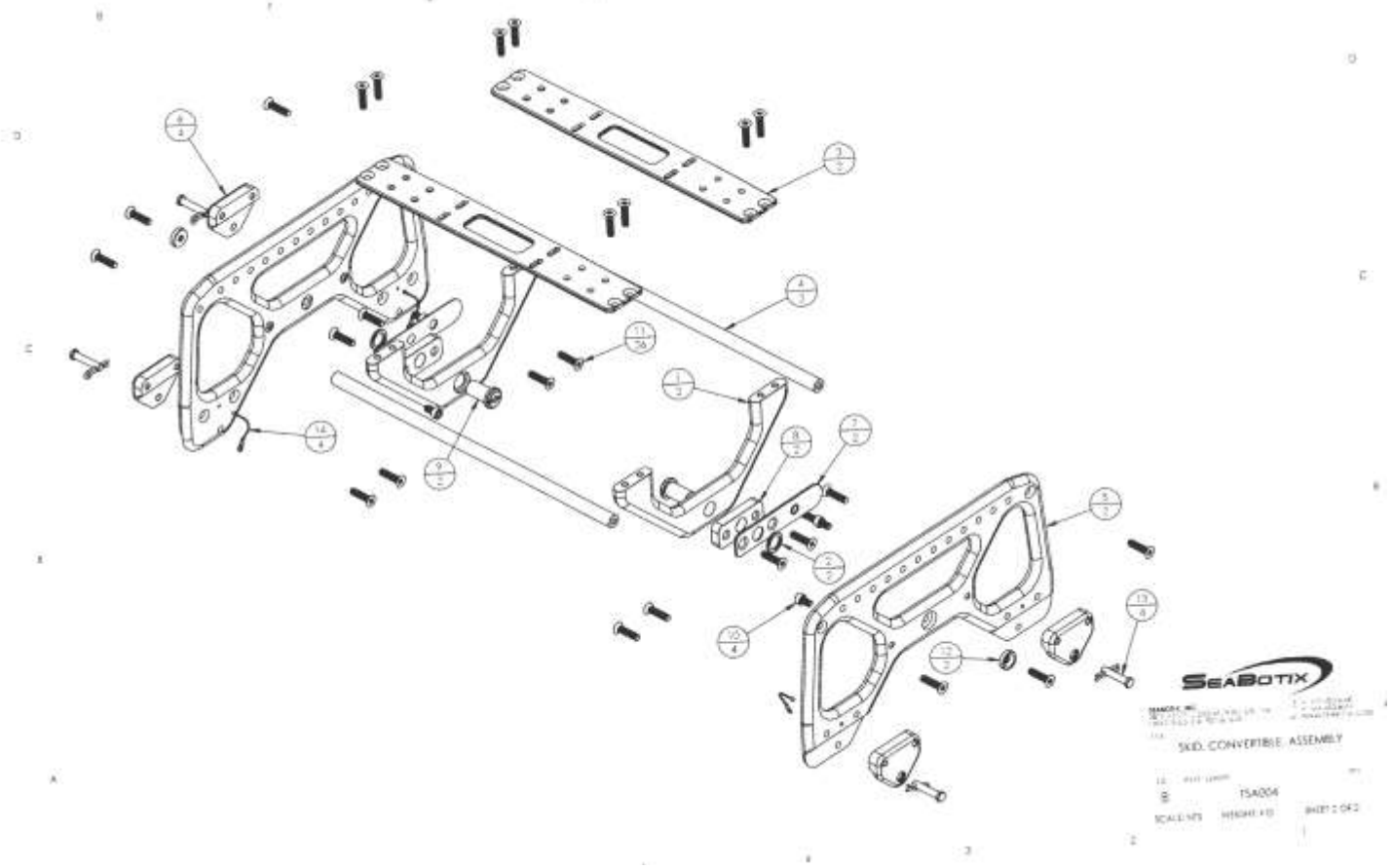
The tabs will lock into place on the screw heads preventing rotation during operation.

Refer to sections K.2.1 and K.2.2 for examples.

K.2.4 Installing the convertible tool skid

1. Remove the 4 each securing pins from the mount
2. Configure the mount as required for installation referring to section K.2.3
3. Place the mount centered on the bumper frame
4. Install the pins thru the securing holes
5. Install the locking clips thru the holes on the securing pins
6. Connect the power data cable to the connection on the rear of the sonar head
7. Power up the system and test for proper operation of the sonar.

K.3 Exploded Diagram and Bill of Materials



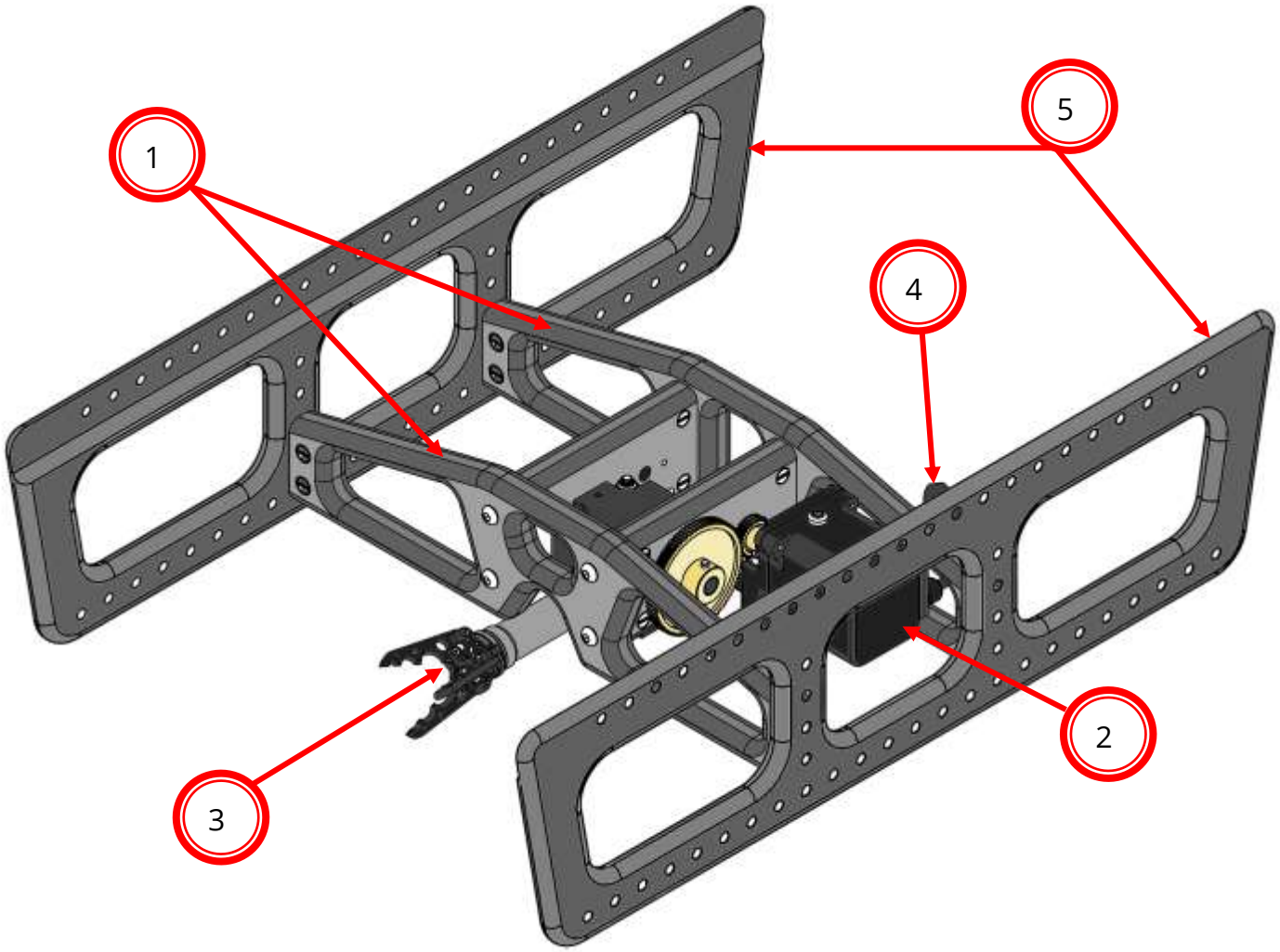
Lvl	Typ	Seq	Part Number	Revision	Alt	Description	Qty/Parent	Required Qty	UM
			TSA004	A		Skid, Convertible, Assembly		1.00000	EA
1	Mtl	1	.MA2511	A		Bumper Frame, Pivot Style, Ins	2.00000000	2.00000	EA
1	Mtl	2	.FN2504			Washer, Flat, .56in ID, .75in	2.00000000	2.00000	EA
1	Mtl	3	.MA2504	A		Plate, Mounting, Sonar	2.00000000	2.00000	EA
1	Mtl	4	.MA2505	A		Threaded Cross Bar, vLBV Conve	2.00000000	2.00000	EA
1	Mtl	5	.MA2509	A		Bumper Frame, Pivot Style, Sid	2.00000000	2.00000	EA
1	Mtl	6	.MA2506	A		Plate, Lock, Clevis Pin	4.00000000	4.00000	EA
1	Mtl	7	.MA2503	A		Lock Plate, Side Frame	2.00000000	2.00000	EA
1	Mtl	8	.MA2507	A		Spring Plate, Inside Side Fram	2.00000000	2.00000	EA
1	Mtl	9	.MA2508	A		Axle Nut, Pivot	2.00000000	2.00000	EA
1	Mtl	10	.FN860			Screw, M6-1.0 x 10, SHCS-SK, 3	4.00000000	4.00000	EA
1	Mtl	11	.FN2511			Screw, Flat Head Socket Cap, M	26.00000000	26.00000	EA
1	Mtl	12	.MA2501	A		Bolt Seat, Axle	2.00000000	2.00000	EA
1	Mtl	13	.FN2512			Clevis Pin, 1/4" Diameter, 1 1	4.00000000	4.00000	EA
1	Mtl	14	.HW2500			Lanyard, 1.2mm X 203.2mm, Eye,	4.00000000	4.00000	EA

Addendum L: Tilt Grabber Assembly TPA010 & TPA011

Installation and operating instructions

NOTE: There is no angular readout for indication of grabber tilt.

L.1 Nomenclature



Major Components

1	Tilt Grabber Mounting Frame Assembly (TPA007)
2	Tilt Drive Motor (MHA007)
3	Right Angle Connection Three Jaw Grabber (TJG300-2I-L-V-RA)
4	Power and Data Connection
5	Tool Pallet Mount Assembly (TPA010/TPA011)

L.2 Installation and operating instructions

L.2.1 Installation:

1) Remove the float from the vLBV by removing the 4 wing nuts from the topside of the float and then lift the float body directly up. Place the float in a safe location.

2) Locate two unused port connections on the bottom of the backplane of the vLBV.

NOTE: Unused ports will be covered with a blanking plug (MA945) which must be removed to access the contacts.

3) Install one o-ring (SL304) per connector. Lubricate the o-ring (SL304) prior to installation using SeaBotix P/N GLA001 per SeaBotix Manual DOCS-020. Install each connector to the backplane using the original mounting screws. Follow the silkscreened foot print on the backplane for proper connector alignment.

4) Position the tool skid so that it is centered on the bottom of the vehicle bumper frame, and secure using 4 ea M6 x 25 SS BHCS (P/N FN304) and 4 ea M6 Nylock Nuts (P/N FN323) on both the Port and Starboard side of the skid frame.

5) Re-Install the float using the 4 original wing nuts. Connect and power up the system per section 1.4.3. After the system has completed the initialization calibration sequence, cycle the SELECT button on the hand controller until GT is displayed in the Accessory position in the video overlay.

This completes the section on installation

L.3. Operation the Tilt Mechanism

Operation of the tilt mechanism for the grabber is controlled via the hand controller.

Once the operator has selected GT as the Accessory with the SELECT button on the OCU, control of tilt is done via the Left and Right Arrow buttons

Press the SELECT button until GT is displayed in the accessory section of the video overlay.

The left facing arrow will tilt the grabber up

The right facing arrow will tilt the grabber down

Once the grabber is in the desired position, press the SELECT button until GR is displayed in the accessory section of the video overlay

The right facing arrow will open the grabber

The left facing arrow will close the grabber

L.4 Operator Tips

L.4.1 Setting the grabber zero position

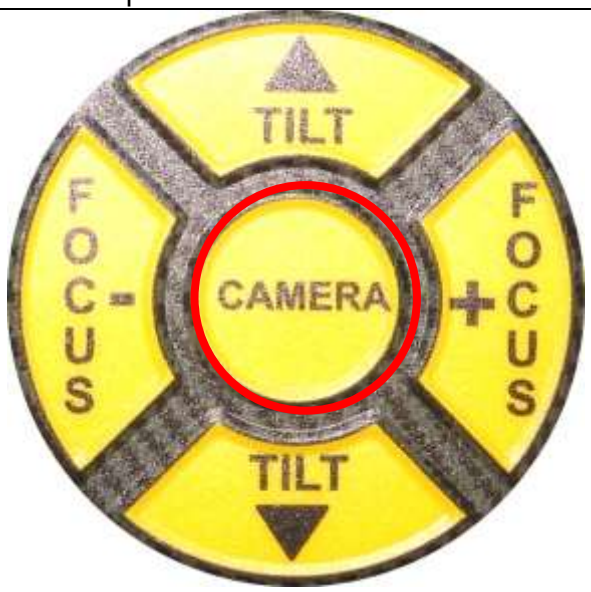
1) Tilt the grabber to a mechanical stop position (horizontal or vertical) per section L-3, and hold the tilt control for 15 seconds after the grabber has stopped moving. The operator may have to tilt the grabber up to Horizontal or down to Vertical depending on which way it was knocked out of position

L.4.2 Position the grabber

1) Set the grabber in the downward position per section L-3.

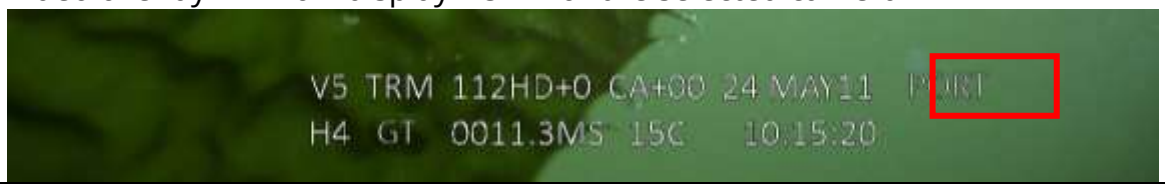
L.4.3 Camera selection

A secondary camera in the Port position should be installed to monitor the grabber in the downward position.



To Select the Port Camera:

1) Depress and hold the CAMERA button on the OCU, and select 7 in the numeric keypad section.
2) Release the CAMERA button
3) Video overlay will now display PORT for the selected camera



L.4.4 Ensure that the grabber is tilted to the horizontal position prior to de-energizing the system

L.4.5 If the grabber will not tilt to the full vertical or full vertical during operation reset the zero position per section L.4.1.

If the grabber is bumped out of position due to impact or load, section L.4.1 is to be used to reset the grabber tilt zero point.

L5 Recovering objects using the Grabber Tilt Mechanism in the Vertical Orientation

a) With the grabber oriented in the horizontal position, maneuver the vLBV into position over the object to be recovered

b) Switch the camera displayed to the Port camera, now rotate the grabber to the vertical position.

c) Maneuver the vLBV till the grabber jaws encompass the object to be recovered, close the jaws to secure the vLBV to the object.

d) Increase the Vertical Thruster Gain as needed to lift the object for recovery.

L6 Recovering Objects using the Grabber Tilt Mechanism in the Horizontal Position

a) With the grabber oriented in the horizontal position, maneuver the vLBV into position for the object to be recovered.

b) Maneuver the vLBV till the grabber jaws encompass the object to be recovered, close the jaws to secure the vLBV to the object.

c) While tilting the Grabber to vertical, operate the vertical thrusters to lift the vLBV above the object.

d) Increase the Vertical Thruster Gain as needed to lift the object for recovery.

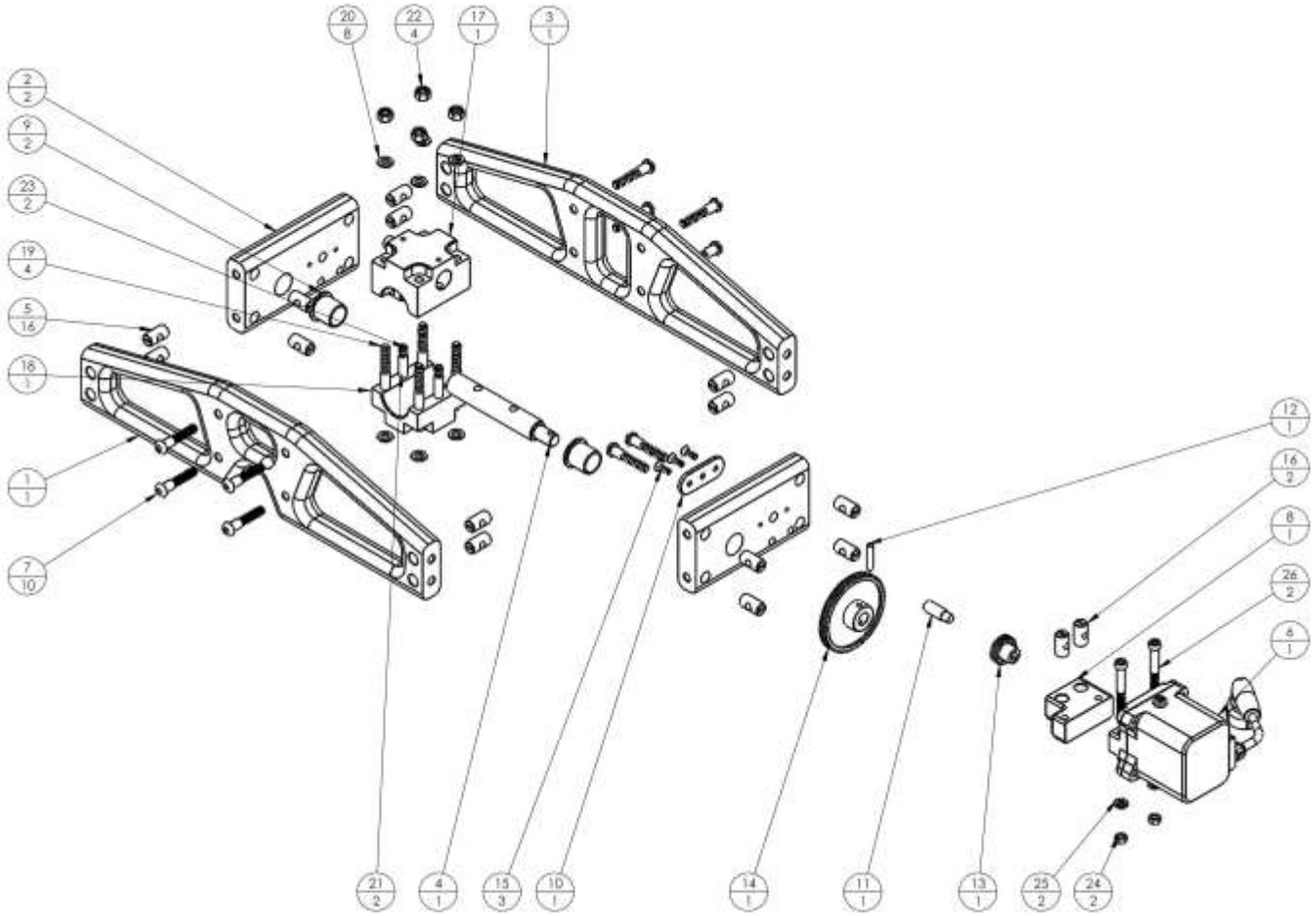
Do not attempt to lift heavy objects with the grabber in any position other than full vertical, equipment damage may result

The grabber is not designed to attach to hard flat objects i.e. metal. Lifting pad eyes are acceptable attachment points. If possible attach to soft material such as rope. Damage to the jaws may result.

For large hard objects, only attempt to attach with the grabber in the vertical orientation. Damage to the jaws may result.

The tilt mechanism can be moved out of position during normal operation and testing by mechanical force. This will not damage the mechanism or electronics.

L.5 Exploded Diagram and Bill of Materials



Prog: bmr30 — SeaBotix, Inc. — Page: 1
User: Markp — BILL OF MATERIAL REPORT — Date: 06/10/14
SINGLE LEVEL — Time: 8:22 am

Lvl	Typ	Seq	Part Number	Revision	Alt	Description	Qty/Parent	Required Qty	UM
			TPA007	C		Tool Pallet Assy		1.00000	EA
1	Mtl	1	.MA1158	B		Ball Clamp Male	1.00000000	1.00000	EA
1	Mtl	2	.MA1551	B		Cross Brace, Pillow Block, Til	2.00000000	2.00000	EA
1	Mtl	3	.MA1562	B		Rear, Cross Brace, Tilt Mech M	1.00000000	1.00000	EA
1	Mtl	4	.MA1563	B		Tilt Axle	1.00000000	1.00000	EA
1	Mtl	5	.MA1116	A		Insert, M6, Perpendicular, Ace	16.00000000	16.00000	EA
1	Asm	6	.MHA007	A		Motor Housing,Tilt Motor, Grab	1.00000000	1.00000	EA
1	Mtl	7	.FN395			Screw, M6 x 35, Button Head	10.00000000	10.00000	EA
1	Mtl	8	.MA1557	B		Motor Mount, Tilt Mech	1.00000000	1.00000	EA
1	Mtl	9	.FN292			Bearing, Flanged, .625" ID X .	2.00000000	2.00000	EA
1	Mtl	10	.MA1555	B		Base, Pulley Bracket, Tilt Mec	1.00000000	1.00000	EA
1	Mtl	11	.MA1556	B		Bracket, Pulley, Tilt Mech	1.00000000	1.00000	EA
1	Mtl	12	.FN294			Dowel Pin, M4x22mm, 316SS	1.00000000	1.00000	EA
1	Mtl	13	.MA1570	B		Gear, Drive, 30 Tooth, 21 PD	1.00000000	1.00000	EA
1	Mtl	14	.MA1571	B		Gear, Drive, 90 Tooth, 63 PD	1.00000000	1.00000	EA
1	Mtl	15	.FN065			Screw, M4 x 12, Phillips Flat	3.00000000	3.00000	EA
1	Mtl	16	.MA921	A		Insert, M6, Perpendicular, Bra	2.00000000	2.00000	EA
1	Mtl	17	.MA1560	C		Lifting Axle Block	1.00000000	1.00000	EA
1	Mtl	18	.MA1559	B		Lifting Axle Block Cover	1.00000000	1.00000	EA
1	Mtl	19	.FN291			Bolt, M6 X 55mm, BHSCS, 18-8 S	4.00000000	4.00000	EA
1	Mtl	20	.FN833			Washer, M6, Flat, 316SS	8.00000000	8.00000	EA
1	Mtl	21	.FN293			Dowel Pin, M6 X 20mm, 316 SS	2.00000000	2.00000	EA
1	Mtl	22	.FN323			Nut, M6, Nyloc	4.00000000	4.00000	EA
1	Mtl	23	.FN589			Screw, Set, M6 x 25, Flat Poin	2.00000000	2.00000	EA
1	Mtl	24	.FN618			Nut, M5 Nyloc	2.00000000	2.00000	EA
1	Mtl	25	.FN692			Washer, M5, 10mm OD, 316 SS	2.00000000	2.00000	EA
1	Mtl	26	.FN226			Screw, M5 x 45mm, BHCS, 18-8 S	2.00000000	2.00000	EA

Glossary of Abbreviations and Terms

The following abbreviations and terms are used when discussing the LBV/vLBV and accessories.

BNC	Video Input and Output Connectors used by SeaBotix Inc.
Bulkhead Connector	**Bulkhead connectors** are devices for connecting external devices to the LBV/vLBV electronics. It is a physical connector that is mounted and acts as a seal for the housing.
CC	Camera Chassis
CSA	**Crawler Skid Assembly.** A sub-assembly of the LBV/vLBV system allowing the operator to attach the LBV/vLBV to any relatively flat surface for stability while performing inspections.
DTA	Depth and Temperature Assembly
ELS	External Lighting System
Flash Program	Operational Program for the LBV/vLBV
FO	**Full Fiber Optic data and video**. All data to and from the LBV/vLBV and the video feed from the LBV/vLBV is transferred via fiber optics.
FOE	**Fiber Optic Ethernet data.** This designation is utilized for systems requiring an Ethernet data link to transfer data from the LBV/vLBV.
FOV	**Fiber Optic Video**. This style is used for tethers over 150m in length. The composite video signal from the LBV/vLBV is converted to fiber optic data in the tether and made available as a composite signal at the MUX hub of the tether reel system.
FSK	**Frequency Shift Keying**. A method of data transmission utilizing 2.5 channels of RS232 format for command and control of the LBV/vLBV. Data transmission to an external RS232 device with a remaining simplex channel for data to a device attached to the LBV/vLBV.
GAK	**Grabber Attachment Kit.** Consists of the parallel jaws, the standard interlocking jaws and the cutter jaws.
GFI	**Ground Fault Interrupt** Circuits designed to detect voltage leaking to ground. These circuits are designed to remove all input voltage whenever the design trip point is reached.
Hardware	All hardware descriptions prefixed with the letter M (M5x15) indicates the fastener is a metric fastener. The 1st number is the diameter in mm (millimeters,) and the 2nd number is the fastener length in mm. Hardware listed at ¼-20 x 1.5 is an imperial fastener. The 1st number is the diameter, the 2nd number is threads per inch and the final number is length. Smaller imperial fasteners are numbered. For example, the seal screw utilized on thrusters, grabbers and the vacuum port is a 10-32 x 3/8. So it is a #10 screw, 32 threads per inch and 3/8's of an inch in length.

HIA	**Housed Inverter Assembly** Weather resistant DC inverter power supply for vLBV systems
Horiz	Horizontal.
HPDC	High Performance **Brushless** Thruster
ICC	**Integrated Control Console.** This console is used for command and control of the LBV/vLBV and video display only! It has external data connections for exporting SONAR and tracking to a separate display device.
INC	**Integrated Navigational Console.** A one unit solution for operators of LBV/vLBV's equipped with SONAR and or navigation systems. The monitor displays both the LBV/vLBV video and the SONAR/tracking information on a single monitor. It is also equipped with a hard drive and video recording equipment, so that the information can be recorded into a single file on the hard drive.
LBL	**Long Base Line** systems utilize three or more acoustic transponders on the seafloor to communicate with a beacon on the LBV/vLBV/LBC. By triangulation with the ship (and its GPS), the position of the transponders can be accurately determined and then used to determine the position of the LBV/vLBV/LBC. LBL is the most accurate type of acoustic tracking system but it has several drawbacks including the lengthy time to set up and calibrate the cost of multiple transponders and the ability to only track the LBV/vLBV /LBC when it is within range of all of the seafloor transponders. A variant of this approach is the inverted LBL which uses transponders on surface buoys (each with GPS receivers) instead of ones on the seafloor.
LBV	Little Benthic Vehicle
lwLARS	**Light Weight Launch and Recovery System.** A self contained tether management system with operator controlled automated payout and recovery of the tether and the LBV/vLBV.
MB	Motherboard
MUX	**Multiplexer.** This function is contained in the POH and converts the fiber data to electrical data prior to the slip ring assembly for use by the operator.
NCC	**Navigation Control Console**. A processor unit and display console developed for display and control of SONAR and Tracking systems. It is used in addition to the ICC.
OCU	Operator Control Unit.
OOK	**On-Off Keying**. The simplest method of command and control of the LBV/vLBV with no additional data channels. Utilizing RS232 duplex from the OCU to the LBV/vLBV via the Surface Power Supply.
PCA	Printed Circuit Card Assembly

Penetrator	A **Penetrator** is used to connect an external device electrically to the circuitry inside the sealed housing. In a penetrator style connection, the cable actually passes into the housing of the unit without a connector.
PIC	**Programmable Integrated Circuit.** Used extensively on the circuit boards to pre-program them for functions as required.
POH	**Pull Out (multiplexer) Hub**. Part of the URS. It contains the MUX as well as the termination point for the tether and the tether whip.
PSI	**Power Supply Interface** Circuit Board; part of the VPS
QRS	**Quick Recovery System**. A manual system used to ease recovery of the LBV/vLBV by attaching a plate to the tether and allowing the operator to recover the LBV/vLBV without handling the tether directly.
RF	Radio Frequency
RF Coupler	**Radio Frequency Coupler Board**. Used in non FO LBV/vLBV's to couple and decouple data and video to the tether.
RF Demod	**Radio Frequency De-Modulator.** Used in non FO & FOV LBV/vLBV's to convert the RF video signal to composite video for display.
RF Mod	**Radio Frequency Modulator.** Used to up and down convert the RS232 data from the OCU and the LBV/vLBV to RF for data transmission via the tether.
ROV	Remotely Operated Vehicle
RS232	Electronics interface communications mode
SB	**Sensor Board**. Used to convert the analog data signals from the internal and external LBV/vLBV sensors to digital format for display and utilization by the "Auto" modes of the LBV/vLBV.
SBL	**Short Base Line** systems consist of one beacon on the LBV/vLBV/LBC and three or more hydrophones hanging over the side of the ship, dock, or other surface structure. SBL systems have the advantage of not needing to deploy and calibrate seafloor transponders. It has accuracies and costs that are intermediate to the other two methods.
SBT	Standard **Brushed** Thruster
TSA500	**Blue View Multi-Beam SONAR.** This SONAR device is a multi-beam. It provides a real time image for its full horizontal (45^0) and vertical (20^0) aperture. Since the update rate is continuous for the full aperture the strengths of this device are: Search while moving. Higher target image resolution making it easier for the operator to identify targets.

TSS750	**Micron Scanning SONAR.** This SONAR device is a scanning or searchlight style. It has a maximum range of 100 meters with a vertical beam width of 32 degrees. It has the advantage of being able to search in 360 degrees around the LBV/vLBV/LBC but update rate is range dependant. The system can only display target information for where the acoustic transmitter/receiver is pointed at this time.
SONAR	**Sound Navigation and Ranging.** SeaBotix Inc. offers 2 primary versions of SONAR for installation. Micron Scanning SONAR. (TSS750) Blue View Multi-Beam SONAR.
SPS	**Surface Power Supply**. Converts supply AC power to DC at ~360 VDC for transfer to the LBV/vLBV via the tether.
SPS3000	**3000 Watt Surface Power Supply**. Converts supply AC power to DC at ~360 VDC for transfer to the LBV/vLBV via the tether used on all 6 thruster LBV/vLBV's
TJG	Three Jaw Grabber
TMS	Tether Management System
Tracking	Acoustic Tracking Systems Since GPS signals do not penetrate through water, acoustic methods have been devised to allow the operator to know the position of the mini-ROV at all times. This is very helpful for a variety of reasons, including navigating search patterns and re-locating underwater objects. All acoustic tracking systems rely on beacons which can be pingers which emit a sound pulse at a predetermined interval, transponders which emit a pulse in response to a specific acoustic interrogation pulse, or responders whose pulse is triggered via a wire from the surface. The beacon(s) pulse is detected by a hydrophone suspended from the surface and connected to a processor unit or controller which determines range and bearing. There are 3 basic configurations for tracking systems. **LBL, SBL** & **USBL** (Refer to each section for further definition.)
uLARS	**Un-Manned Launch and Recovery System**. A remotely controllable launch and recovery system. Consisting of a tether reel system, surface power supply, a power sheave, and control circuits for remote launch and recovery of the LBV/vLBV system.
UMB	Tether
URS	Tether Reel System
USBL	**Ultra-Short Baseline** systems are similar to SBL except that instead of using the three surface hydrophones, a single multi-element hydrophone array is used instead. This makes them the quickest tracking system to set up and the least expensive of the three methods, although their accuracy is not as high. USBL systems have proven to be the most popular acoustic tracking system used on mini-ROVs and several companies now make USBL systems specifically for this platform.

Vert	Vertical
VGA	**Video Graphics Array** format for video display
vLBV	Vectored Little Benthic Vehicle
VOB	**Video Overlay Board.** Creates the characters for displaying the video overlay information from the LBV/vLBV onto the monitor.
VPS	**Vehicle Power Supply.** Converts the ~360 VDC tether supply voltage to the 28 VDC required for the LBV/vLBV operation.

Warranty

SeaBotix Inc. is committed to the highest standard of quality in the production of the LBV/vLBV. Each LBV/vLBV system is covered with a twenty four (24) month or 500 hour (whichever comes first) limited warranty against defects in workmanship or materials with the exception of those outlined in the Limitations and Exclusions section contained herein. The purchaser of an LBV/vLBV requesting warranty work or repairs must supply to SeaBotix Inc., or an authorized representative, proof of ownership along with the system. SeaBotix Inc. will, at its discretion, repair or replace the defective components.

Limitations and Exclusions

The limited warranty does not cover damage caused by improper use, poor maintenance or accidental damage to the LBV/vLBV.
The limited warranty does not cover items subject to wear including but not limited to view ports, outer shells, o-rings, batteries, protective bumper frame, tether and propellers unless found to be defective in workmanship and/or materials.
The limited warranty does not cover any alterations or modifications made to the LBV/vLBV without prior authorization from SeaBotix Inc.
The limited warranty does not cover lamps.
The limited warranty does not cover components damaged due to incorrect power connection.

Shipping Charges

All returns for warranty service must be authorized by SeaBotix Inc., and will be assigned an RMA (Returned Materials Authorization) number which must be clearly indicated on each item returned for service.
After 30 days following receipt the client is solely responsible for shipping to and from an authorized SeaBotix Inc. warranty center. Warranty centers are located around the world to help reduce transit time and distance required for warranty repairs or service.

Return Policy

SeaBotix Inc. is strongly committed to the highest quality production facilities and customer satisfaction is our top priority. To achieve this goal, SeaBotix Inc. is happy to offer a full refund on any of our standard products that are returned within 30 days of the date the items were shipped. If for any reason you are not satisfied with our products, simply notify us by calling (619) 450-4000 or email us at: service@seabotix.com. SeaBotix Inc. will immediately issue a Return Material Authorization (RMA) number. When requesting an RMA number please have the following information ready: name of owner, name of distributor if any, product being returned, and the last four digits of the product serial number.
Items being returned must be in “AS NEW condition”. “AS NEW Condition” means that there are no scratches, marks, blemishes on the item; there are no signs of wear on the product, or the cases, and the product has not been altered or modified in any way. The following conditions must be met for warranty-covered repairs.

Return the merchandise to us within 30 days of the date the items were shipped.
The product must be returned in as new, resalable condition.
All packaging materials must be included and not be torn or damaged.
All manuals must be unmarked.
All return shipping charges must be prepaid.
The RMA number must be prominently displayed on the outside of the shipping container to avoid delays in processing your return.

Upon receipt of the returned merchandise in good order, and in accordance with the above provisions, SeaBotix Inc. will promptly refund your purchase price.